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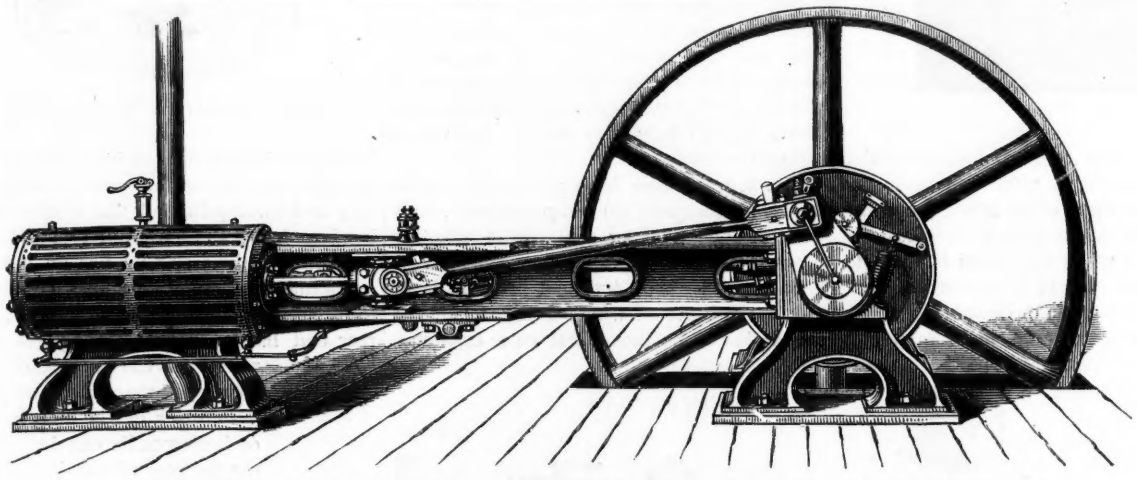


FIG. 1.—FRONT VIEW OF THE BUCKEYE HIGH-PRESSURE AUTOMATIC CUT-OFF ENGINE.

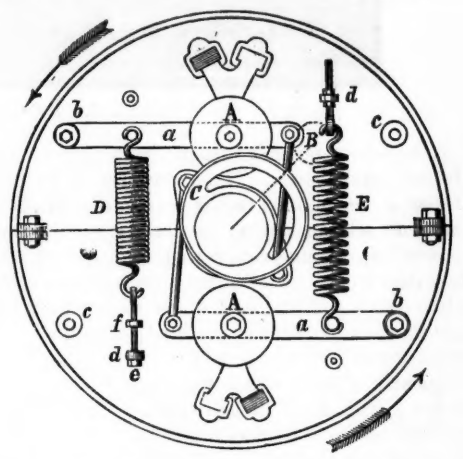


FIG. 4.—CONSTRUCTION OF THE GOVERNOR.

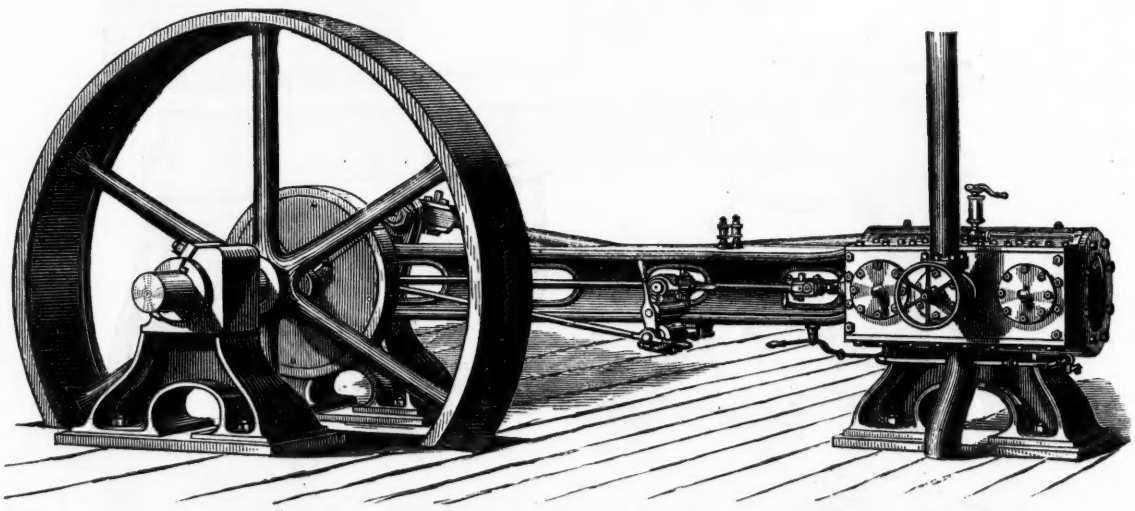


FIG. 2.—BACK VIEW OF THE BUCKEYE HIGH-PRESSURE AUTOMATIC CUT-OFF ENGINE.

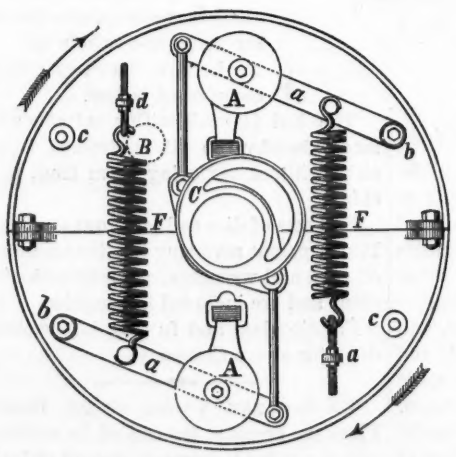


FIG. 5.—CONSTRUCTION OF THE GOVERNOR.

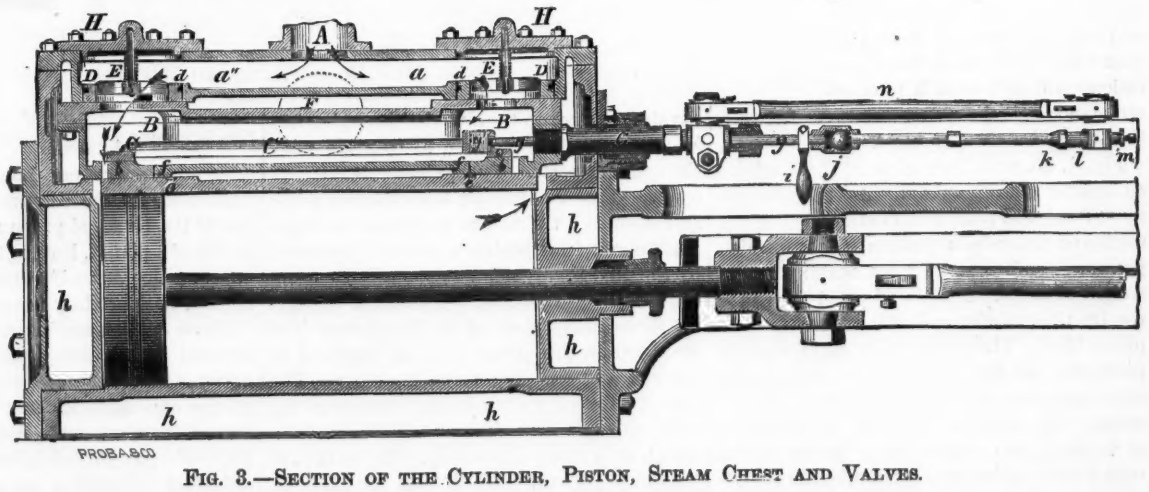


FIG. 3.—SECTION OF THE CYLINDER, PISTON, STEAM CHEST AND VALVES.

Improvements in Steam-Engines.

BY STEPHEN ROPER, ENGINEER.

The most valuable features of a steam-engine are strength, symmetry of design, good proportions, durability, simplicity, and convenient arrangements for the adjustment of its working parts, as its economy will depend, to a certain extent, on the harmonious action of its reciprocating and revolving mechanism. Defects in design entail more difficulty in the working of any class of machines, steam-engines included, than defects in workmanship, as a well designed and poorly constructed engine can be rebuilt and refitted, but defects arising from bad design can never be remedied. Before purchasing an engine, or any other machine, there are points to be considered which involve its commercial value, among which are, the amount which it would save or earn in excess of another machine when in use, and the time during which it would run without repairs, or the addition of any expenditure to its first cost.

In Watt's time, one cubic foot or 62½ lbs. of water was the allowance per horse-power per hour for average engines, but the water consumption for most engines was from 75 to 80 lbs., while the better class of modern automatic cut-off high-pressure engines will yield a horse power from a water consumption of from 20 to 25 pounds. Yet there are engines in use at the present day which use from 65 to 70 lbs. of water per horse power per hour. Now, admitting that the evaporative efficiency of steam-boilers, under the best conditions, is 8 lbs of water per pound of coal, providing the water consumption of an inferior type of engine is one cubic foot or 62½ lbs., it would require 7¾ lbs. of coal. or its equivalent in other fuel, to develop a horse-power, while with one of the best class of improved automatic cut-off engines, *such as is shown in the annexed cut*, the same power would be yielded from a water consumption of less than 25 lbs. and the combustion of 3 lbs. of good coal. In the best types of the steam-engine, the principal expense, besides first cost, is fuel, but in inferior classes of engines, the cost of maintenance, such as lining up and renewal of the different parts increases annually until in a

few years the cost, in many instances, exceeds that of the fuel. It is to such considerations as these that steam users should direct their attention when about to purchase steam-power or replace a worn out engine with a new one.

It has not been the custom heretofore for those needing steam-power to purchase the most economical engines, but rather to buy

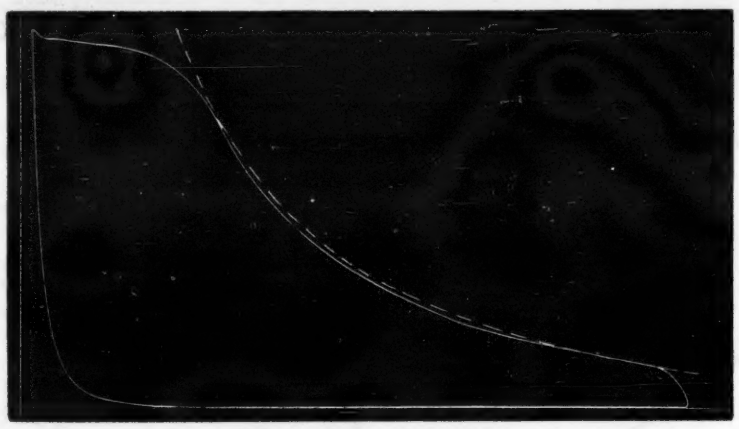


FIG. 6.—INDICATOR CARD.

for the lowest possible first cost regardless of future maintenance. Manufacturers of inferior steam-engines, being aware of this, agree to sell an engine of a certain horse-power for a certain price, perhaps 25 per cent. less than would be asked for a first-class machine; now, the first cost of an engine is of but minor importance in comparison with its consumption of steam, and consequently of fuel, which reduces it to a matter of dollars and cents, and the question is necessarily re-resolved into "which is the best?"

Another objection raised against the use of the most improved class of steam-engines is that their care and management require a great amount of skill. On the other hand, one of the most prominent recommendations urged by the manufacturers of inferior steam-engines was that they required little or no care, in fact that a boy could run them. Now, every one knows, or, at least, should know (steam users in particular), that good machinery requires good care, no matter how simple it is; it may require little attention and almost run itself, yet, it should have good care and intelligent treatment. To do good work with good tools requires a skillful workman, and the extra wages paid to a skillful engineer will not lessen economy. There are two conditions involved in the use of steam, viz., the generation and the application of it, and the man who understands these conditions will save enough to counterbalance the difference in wages between himself and a cheaper hand.

Fig. 1, shows a front view of the Buckeye automatic cut-off engine. As may be observed the bed-plate is a modification of the Corliss or girder-frame pattern, a design which possesses sufficient rigidity without extra weight of metal. It is faced up at one end to receive the cylinder and at the other the main pillow block. The cylinder contains the steam-ports, but not the exhaust-ports, and, as the valve-faces are as near the cylinder as is consistent with sufficient strength, the clearance is reduced to a minimum, a feature which renders the engine very economical in the use of steam. The cross-head is made in halves, is held together by bolts, and is attached to the piston-rod by means of a thread on the rod. The cross-head shoes move in flat guides and can be easily adjusted by means of screws and jam-nuts.

Fig. 2, Shows a back view, and Fig 3, a section of the cylinder, piston, steam-chest, and valves.

Fig 3, As will be observed, the live steam enters at A into the passage *a a* in the back cover of the valve-chest, from which it passes to the interior of the hollow steam-tight valve B B, which is closed at each end by covers securely bolted on. These covers are accurately faced on their outer surfaces and work in contact with the equilibrium rings or pistons D E, *d*, and *d*, E D, which, being fitted steam-tight into openings at the ends of the passage *a a''*, serve to prevent the live steam in *a a''* from escaping into the valve-chest, while they allow it to pass freely into the centre of the valve B B when in motion. These rings have arms and central hubs, to which are fitted stems which enter sockets in the caps H H. Around these stems are spiral springs which hold the rings to their seats on the valve-covers when the steam is shut off. By removing the caps H H the rings may be taken out for inspection or cleaning,

From the interior of the main valve B B the steam passes to the cylinder through ports *b b* when they are brought to coincide with the cylinder ports. The exhaust is effected by the valve uncovering the cylinder ports and allowing the steam to escape into the valve-chest, from which it passes downward by the pipe F. By this arrangement the usual conditions are reversed, the exhaust occupying the ordinary place of the live steam. The arrows show the steam as it is admitted to one end and escaping from the other. The cut-off valves C *c* work in the interior of the main valve B on seats around the ports *b b* which they cover alternately. The stem *g*, of the cut-off valves, work through the stem G, of the main valve, which is made hollow for the purpose. The main valve is driven by a fixed eccentric in the usual manner. An adjustable eccentric, the position of which on the shaft, is under the control of the governor, works the cut-off valves. A novel feature of the cut-off valve gear is a rock-shaft working in a bearing in the rocker-arm belonging to the main-valve gears. The adjustable eccentric is attached to a pendent arm on the outer end of it, and a similar but vertical arm on the inner end connects it to the head *l*, and thus works the cut-off valve. The effect of this device is to secure a correct movement of the cut-off valves, relatively to their seats in the moving main valve, and at the same time effect a degree of adjustment of the cut-off exactly corresponding to the degree of change in the angular position of the eccentric, neither of which is possible without such an arrangement.

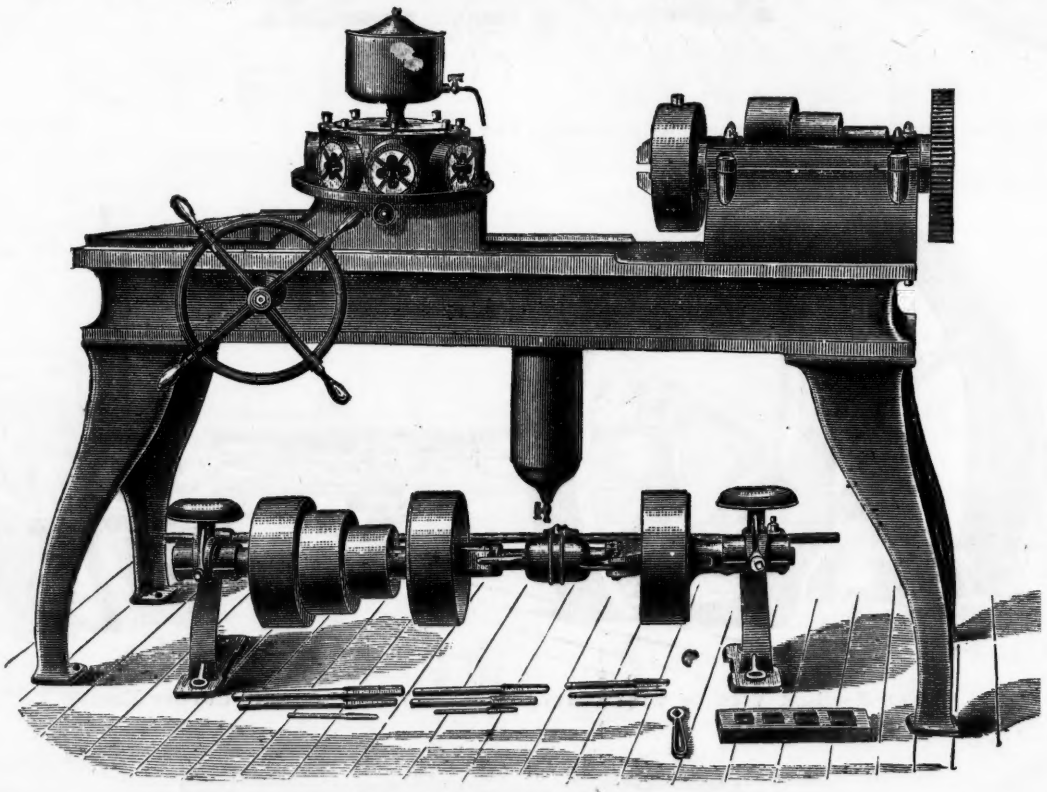
Figs. 4 and 5, show the construction of the governor. The levers *a a*, to which are attached the weights A A, are pivotted to a disc at *b b*, at one end, and to the ears of the adjustable eccentric C at the other, so that their outward movement, in obedience to centrisugal force, advances the eccentric *cc*, turns it forward in the direction the engine runs, thus giving an earlier or later cut-off according to load or steam-pressure. Besides, this arrangement admits of such an adjustment of spring tension as will cause the centrifugal and centripetal forces to increase and diminish in the same ratio, or as nearly so as desired, as the weighted lever moves outward and inward, which, without sacrificing stability, approaches isochronous regulation more nearly than has been attained by any other device employed for this purpose. The proper speed to meet any requirement may be obtained by increasing the weights or moving them in or out on the levers.

Fig. 6, was taken from a Buckeye engine 22x44, piston-speed 520 feet per minute, scale 40, clearance 1.75 per cent., mean effective pressure 36 lbs. It shows very perfect performance. Its total terminal pressure is 22 lbs., the volume of which being 1,123, the calculation of its theoretical water consumption becomes $\frac{859{,}375}{1{,}123 \times 36} = 21.25$ lbs. per *indicated horse-power* per hour, from which the deduction for the compression, in excess of the 22 lbs. terminal pressure will be about $\frac{1}{23}$d or .96 of a pound, leaving 20.29, which shows an economy that—if equalled by any other engine, has certainly never been excelled.

These engines are in very general use, and are said to be among the most durable and economical in the country. They are made of the best material and thoroughly fitted. One of them on exhibition at the *Centennial Exposition*, at Philadelphia, was an object of universal admiration on account of its symmetry of design, elegant proportions, and smooth and noiseless movement. They are manufactured (both condensing and non-condensing) by the Buckeye Engine Company, Salem, Ohio, under J. W. THOMPSON's patent.

Eastern Office and Salesroom, 87 Liberty street, New York. Wm. Lee Church, Engineer in charge.

HARDENING WOOD FOR PULLEYS.—After a wooden pulley is turned and rubbed smooth, boil it for about eight minutes in olive oil; then allow it to dry, and it will become almost as hard as copper.

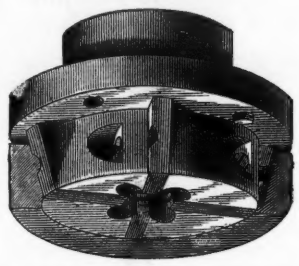


NEW BOLT THREADING MACHINE.

New Bolt-Threading Machine.

The Bolt-Threading Machine shown is from the manufactory of The Pratt & Whitney Co., of Hartford, Conn. It is designed more especially for a jobbing machine, that is, where only a few bolts of a kind are wanted at one time. Like all the machines from the manufactory of this company, it is made in such a manner as to do away with all unnecessary labor in operating it, and at the same time to have all the requisites of a first-class bolt-threading machine.

All the dies are in collets and are arranged



BOLT THREADING MACHINE DIE.

in a revolving cylinder or head, and to bring any die into position for work it is only necessary to draw a spring bolt and revolve the die-head to bring the die wanted in a line with the spindle. The spindle has on the front end a universal chuck for holding the work to be cut or the tap for threading nuts. The rear end has a gear which engages with a pinion on the back shaft which carries a three graded cone pulley.

In place of the dies, box-tools or hollow-mills can be used for the purpose of turning cap-bolts or any such work that requires to be faced true under the head: thus doing in a superior manner more than five times the work that can be done on an engine lathe.

The machines are made in several sizes and for both hand and power.

The collet or body of the die is made of cast iron and is encircled with a wrought-iron ring and contains four cutters or chasers. The chasers are beveled at their back and fit a corresponding bevel in the ring, and to adjust the die it is only necessary to raise or lower the ring, which is done by means of screws.

The chasers of the die are made interchangeable and this form of make is original with this Company: in case of breaking one chaser, it can be replaced with another at one-quarter the cost of replacing the whole die. This, we believe, has never been accomplished before.

The bed is made with a suitable arrangement whereby the oil is drained from the chips without removing them from the machine.

Full sets of dies and taps, nut-tapping vice, Pratt's patent reversing friction countershaft, oil-tank and wrenches, are sent with the machine and are included in the price.

For circulars and further information address the above Company.

TO SET THE VALVE OF AN ENGINE.—Place the crank at the end of its stroke, and give the valve the proper amount of lead; reverse the crank to the other end of its stroke, and if the valve has the corresponding amount of lead it is correctly set. The preponderance at either end, if any exists, must be equally divided. Be careful in adjusting the nuts attaching the valve to the rod, that they do not impinge against the valves, preventing it from seating true. In adjusting the slide valve to cut off at any point of the travel of the piston, the eccentric should be moved forward in proportion to the amount of lap given to the valve, without any reference to the expansive working of steam, the valve must open at the same point of travel of the piston.

GEARING A LATHE FOR SCREW CUTTING.—Every screw-cutting lathe contains a long screw called the lead screw, which feeds the carriage of the lathe, while cutting screws; upon the end of this screw is placed a gear to which is transmitted motion from another gear placed on the end of the spindle; these gears each contain a different number of teeth, for the purpose of cutting different threads, and the threads are cut a certain number to the inch, varying from 1 to 50. Therefore, to find the proper gears to cut a certain number of threads to the inch, you will first multiply the number of threads you desire to cut to the inch, by any small number, 4 for instance, and this will give you the proper gear to put on the lead screw. Then with the same number, 4, multiply the number of threads to the inch in the lead screw, and this will give you the proper gear to put on the spindle. For example, if you want to cut 12 to the inch, multiply 12 by 4, and it will give you 48. Put this gear on the lead screw, then with the same number, 4, multiply the number of threads to the inch in the lead screw. If it is five, for instance, it will give you 20; put this on the spindle, and your lathe is geared. If the lead screw is 4, 5, 6, 7, or 8, the same rule holds good. Always multiply the number of threads to be cut first. Some, indeed most small lathes, are now made with a stud geared in the spindle, which stud only runs half as fast as the spindle, and in finding the gears for these lathes, you will first multiply the number of threads to be cut as before, and then multiply the number of threads on the lead screw, as double the number it is. For instance, if you want to cut 10 to the inch, multiply by 4, and you get 40; put this on the lead screw, then if your lead screw is 5 to the inch, you call it 10; and multiply by 4, and it will give you 40. Again put this on your stud and your lathe is geared ready to commence cutting.

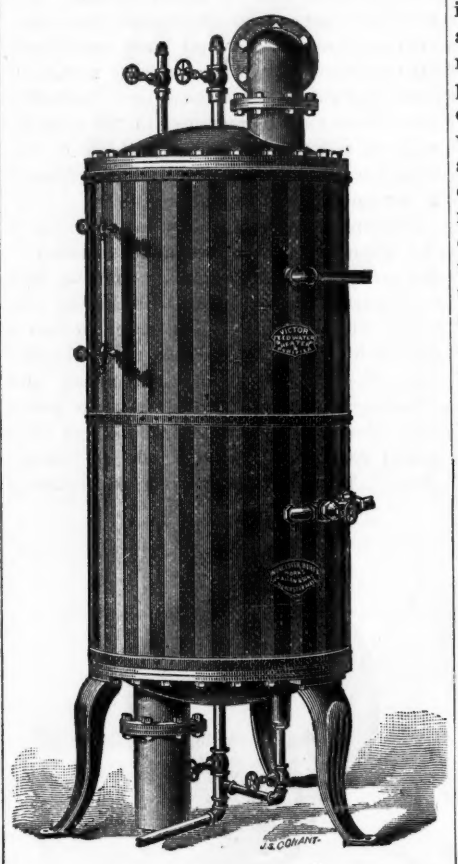
MONGREL THREADS.—Mongrel or half V, half-square threads are usually made for great wear, and should be cut the depth of their pitch, and for extraordinary wear they may even be cut 1½ the depth of the pitch. The point and the bottom of the grooves should be in width one-fourth the depth of their pitch. What is meant here by the point of the thread, is the outside surface. And the bottom of the groove is the groove between the threads. In cutting these threads it is necessary to use a tool about the shape of the thread, and in thickness about one-fifth less than the thread is well finished. As it is impossible to cut the whole surface at once, you will cut it in depth about one-sixteenth at a time, then a chip off the sides of the thread, and continue in this way alternately till you have arrived at the depth required. Make a gauge of the size required between the threads, and finish by scraping with water. It is usually best to leave such screws as these a little large until after they are cut, and then turn off a light chip to size them; this leaves them true and nice.

CUTTING A SCREW IN AN ENGINE LATHE.—In cutting V thread-screws, it is only necessary for you to practice operating the shipper and slide-screw handle of your lathe, before cutting. After having done this, until you get the motions, you may set the point of the tool as high as the centre, and if you keep the tool sharp, you will find no difficulty in cutting screws. You must, however, cut very light chips, mere scrapings in finishing, and must take it out of the lathe often, and look at it from both sides, very carefully, to see that the threads do not lean like fish scales. After cutting, polish with an emery stick and some emery.

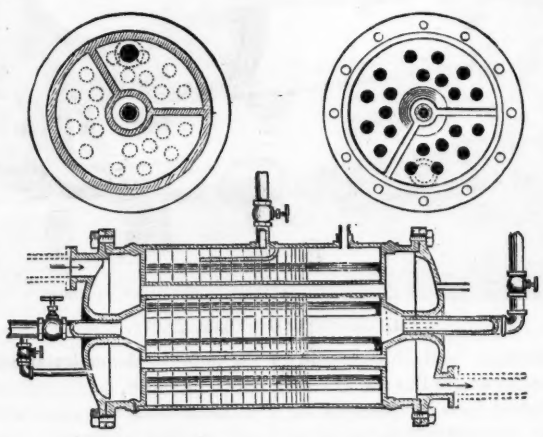
TO MEND CRACKED CAST-IRON VESSELS.—Drill a hole at each extreme end of the crack, to prevent its farther extension, plug rivet the holes with copper, and, with fine iron filings saturated [with urine, caulk the crack. Four parts of pulverized clay, and one part of iron filings made into a paste with boiling linseed oil, and applied hot is a good cement for the same purpose.

Victor Feed Water Heater.

The two illustrations on this page represent the new Victor Feed Water Heater and Purifier, designed for heating water for boilers to a high temperature and purifying the same by removing the sediment lime, vegetable matter, iron, &c., which cause scales and deposits on the inside, which render



the boiler liable to get burned and to explode. It is adapted to be operated in different ways: 1st. With exhaust steam when a large engine is supplied by an ordinary boiler. 2d. With both live steam and exhaust steam where there is a small engine and large boiler capacity. 3d. With live steam alone (on which there is a special claim to the patent) where there is no exhaust. Although recently introduced many heaters are now running in each of the methods above mentioned. This adaptability to different requirements, renders it superior in this respect to any other heater before the public. It is placed upright upon its legs so as to be easily set up and easily fastened to the floor or other foundation, so the pipes can be readily fastened to it. The exhaust steam enters at the bottom and leaves at the top or *vice versa*. It is so constructed that the water condensed from the steam can escape at the bottom. Into the top of the heater connected with the inside apartment, containing the feed water, runs a live steam pipe; from the top of the boiler also, a live steam pipe connects with the tubes as shown in the cuts; similar pipes enter the bottom of the heater, one being a blow-off pipe, through which is blown off all sediment and refuse matter from the feed water and the other, or drip pipe, for the condensed steam. The second pipe mentioned as entering the heater at the top is for the purpose of passing live steam into the tubes when using the heater solely with live steam. Cold water enters the heater at a suitable distance from the bottom so as not to disturb the impurities that have settled, and the feed water is taken to the boiler at a suitable distance from the top so as to avoid the scum on the surface of the water and yet obtain the pure water which is at the top.



The manufacturers claim for this heater that they can remove all lime and iron scale from boilers if the heater is perfectly operated, also prevent the same from entering the boiler. To clean the heater, open the live steam valve at the top which enters the inner shell, then by opening the blow-off valve at the bottom the entire body of water is forced downwards, pushing the mud and sediment out through the blow-off pipe without agitating the clear water above, which remains in the heater after the settlings have passed out. This, it is necessary to do as often as the condition of water requires it; if very foul it should be blown off several times a day, but with ordinary clear water only once a day is sufficient. It being so easy to remove sediment by this process, the engineers would prefer to use this heater rather than allow the dirt to enter the boiler and afterwards take it out through the hand hole, or enter the boiler, and remove it with a chisel as is sometimes necessary. The result of using this heater to heat the feed water is to develop the greatest economy and efficiency in using it solely with exhaust steam, which is advisable where there is large exhaust. In this way the water is fed at from 210° to 212°, this high result being obtained by the heater being of large capacity, and the water feeding slowly through it. With live steam the temperature of the feed water can be raised above the boiling point, as the water, being under pressure, the high temperature of the steam used will heat it to a greater degree, resulting in great economy of coal and benefit to the boiler. The heaters are covered with asbestos and jacketed with black walnut and ash in strips held by brass bands. The tubes are seamless brass.

They are manufactured by Wm. Allen & Sons, Worcester, Mass. We saw one in operation in a shoe manufactory in that city. The engineer had been prejudiced against the heater at the first, but on trial found it to work so easily, saving a large proportion of fuel, and keeping the boiler so clean that he could not speak too strongly in its favor. Some exhaustive tests are now going forward the results of which we may refer to hereafter.

TO IMPROVE POOR IRON.—Black oxide of manganese, — 1 part; copperas and common salt, 4 parts each; dissolve in soft water, and boil till dry; when cool, pulverize, and mix quite freely with nice welding sand. When you have poor iron which you cannot afford to throw away, heat it, and roll it in this mixture, working for a time, reheating, etc., will soon free it from all impurities, which is the cause of its rottenness. By this process you can make good horse nails out of common iron.

GOOD BRASS FOR MACHINERY.—1. Copper, 2 lbs.; tin, 2½ ozs.; zinc, ½ oz. 2. *Tough Brass.*—Copper, 10 ozs.; tin, 1½ ozs.; zinc, 1½ ozs. 3. *Wheels and Valves,*—Copper, 90 lbs.; tin, 10 lbs. 4. *Brass, very tenacious.*—Copper, 88.9 parts; tin, 8.3 parts; zinc, 2.8 parts. 5. *Lathe Bushes.*—Copper, 80 parts; tin, 20 parts. 6. *Machinery bearings.*—Copper, 88 parts; tin, 12 parts. 7. *Boxes for Engines Running at High Speed.*—Copper, 7 lbs.; tin, 1 lb.; add spelter, 1 lb. to every 40 lbs. of the mixture. Use steel piston rods for high speed and lignum vitæ or apple-tree wood for *shoes* or *gibbs* on the cross-heads. Iron for cylinders and guides, if made from pig iron should be melted at least 8 or 9 times previous to use.

TO SOFTEN CAST IRON FOR TURNING.—Steep it in 1 part of aquafortis to 4 of water, and let it remain in 24 hours.

TURNING SHAFTING.—To do this properly, two chips should always be run over the shaft, for the reason that it saves filing, and leaves the shaft truer and more round, and on shafts thus turned, the time saved in filing more than compensates for the time lost in turning. Before you commence you will put your feed belts or gear on a course feed; turn off one a sixty-fourth of an inch larger than the size required; having turned off the chip, commence the finishing chip, and turn it small enough to have the pulley wring on about an inch without filing. This will leave it large enough to file and finish. If there are couplings to go on a shaft, with holes smaller than the holes in the pulleys, the ends of the shaft, where they fit on, should be turned down to a sixty-fourth of an inch of the size required before any part of the shaft is finished; that is, every part of a shaft should be turned to within a sixty-fourth of an inch of the size required before any part of it has the finish-chip taken off. The reason for that is that it leaves every part of the shaft perfectly true, which would not be the case were it done otherwise. Having done this, you will file the shaft so that the pulleys will slide on, and the couplings so that they will drive on; polish the shaft with a pair of polishing-clamps and some emery and it is done.

TEMPERING TOOLS.—Drawing the temper of tools is usually done in a charcoal flame, and to draw the temper of a tool properly it should be held in the thickest part, or the part not requiring any temper, towards the fire and in the meantime, should be often wiped with a piece of waste rag, dipped in oil. The oil keeps the temper even, and prevents it drawing more to one place than another. And in drawing the temper of any tool it should be drawn very slowly, otherwise it will run too far ere you are aware of it. Lancet blades and razors should be drawn to a straw color. Knife-blades and chisels should be drawn to a copper or almost red color. Plane-irons, shaving-knives and shoemakers' knives the same temper; cold-chisels and stone drills should be drawn to a dark blue. Fluted reamers should only be drawn to a straw color, on the end, as they never break elsewhere, and keep their size longer by leaving the lips hard. Half round or tapering reamers, also taps, dies, and drills, should be drawn to a straw color. Jijucs and gauges, also common lathe tools, need no drawing, being tempered enough when merely hardened.

PAPER FRICTION PULLEYS.—These superior mechanical contrivances are made by cutting pieces of pasteboard into a circular form, and of the desired diameter of the pulley, and placing them in layers one on the top of another, cementing properly with a good coat of glue between each layer, pounding or pressing them together as close as possible, and leaving a perforation in the centre of each, for the shaft. When you have got enough of these layers together to give you the proper breadth of pulley, allow the glue to harden, then turn it off to a smooth finish in a lathe. Secure each side of the pulley with a good stout iron flange large enough to cover the entire diameter, or nearly so, and with proper usage it will last a long time.

DIFFERENT STYLES OF FILING.—To file a surface true, it is necessary on commencing, to squeeze the file tightly between the third and fourth fingers and palm of your hand until you become used to it. Your position in filing should be half left face to your work, with the middle of your right foot fifteen inches behind your left heel; and to file your work true or square, it is necessary to reverse your work often, as by this means you are enabled to see the whole surface you are filing and see while filing, whether you are filing true or not. When, however, your work is so heavy that you cannot reverse it, you had better file first to the right and then to the left, as by this means you can plainly see the file marks, and this again assists you in filing true.

Steel Plates.

In a recent number we dealt with the results which had marked the early use of steel plates for boiler-making and ship-building, and we now propose to speak of some of the present aspects of the question. The relative merits, apart from their price, of steel and iron plates might be best decided, if we could compare the number of plates of each kind that turn out defective after delivery at the boiler-maker's and ship-builder's. Could we make this comparison with the plates delivered during the last year or two, we should probably find that the percentage of plates that prove defective is much greater in iron than in steel, and this does not apply only to the notoriously inferior iron plates in the market, but extends also to the plates turned out by many good houses. The question then arises, how can the prejudice be so great in many quarters against the use of steel plates? This will be readily answered by any one having even but a moderate practical acquaintance with the history of inventions and their application. With materials and appliances it is as with other things political and social, "nothing succeeds like success."

Love of novelty on the part of makers and owners will always insure the trial of any promising new invention or application in the first blush of its freshness, but when the charm of novelty has worn off it requires perseverance, self-reliance, and disregard for the opinions of his equals on the part of any one to insure the successful carrying through of any invention or application, which, through some accidental defect in detail of principle has once had a strong prejudice stirred up against it. Had the first marine boilers of the tubulous type been designed with clear notions as to the necessity of providing means for the efficient circulation of the water and escape of steam, this type of boiler would not be now lying in the slough of prejudice, where some of its too sanguine admirers have left it, and from which some time must elapse before it can be lifted. It will probably require this country to be engaged in a more or less disastrous war before the prejudice against the use of breech-loading cannon, which exists on this side of the Channel, can be removed—a prejudice which was caused by the defects in detail in the arrangements first tried. The prejudice against the use of gas engines, again, will probably only die out with the present generation of mechanical engineers who cannot rise above the recollection of the failure of the first engines of this kind, where the advantages of a useful motive force were lost by an application wrong in principle.

The general recognition of the value of steel plates for constructive purposes is fortunately in a much more hopeful condition than some of the inventions just alluded to, yet it offers a strong contrast to the speedy recognition wrought iron plates met with for similar purposes. The task of introducing wrought iron for boiler-making, and afterwards for ship-building, fortunately fell into good hands. Both systems were successful from the very first, and the prejudice against the new application of the material did not survive the stage of evil prognostication. The joints did keep tight, all the rivet heads did not get knocked off, and the boilers and ships did not fall to pieces or rust away so quickly as was prophesied; and now when a boiler is skied or a ship founders through defective material, the faulty iron plates to which the disaster is due do not involve a condemnation of the use of the material generally.

Unfortunately the early employment of steel plates was not so successful. We need not go back so far as the time when so little was known of the properties and behavior of steel that plates were used having a tenacity of 38 and 40 tons. We refer now to the time when it had become generally known that a high tensile strength was incompatible with the other properties, upon the existence of which the successful employment of steel depends.

As long as the Bessemer steel manufacturers could get a high price for rails, tyres, &c., there was no inducement for them to concern themselves very much about perfecting the material for plates, and to instruct the users as to how it should be treated. In consequence of this there was a want of uniformity in the quality of the plates which every new user had to find out for himself and make the best of. In the hands of those boiler-makers who took an active interest in the success of the new material, this want of uniformity led to no great difficulty when they had once learnt what treatment was required. But in most cases where it was the purchaser who wanted steel instead of iron plates, against the boiler-maker's desire not to go out of the beaten track, the amount of trouble and mishaps soon led to its discontinuance.

It was pretty much the same with ship-building. During the American war, when comparatively little was known of the working of the strong steel plates then available, the interest taken by the builders and owners of the blockade runners overcame all difficulties in using steel extensively to suit their purpose. In spite of many other instances besides these of merchant ships built of steel to the owner's order, the price prevented any builder making a specialty of using steel as in the case of boiler-making, until the present demand for steam launches of great speed arose.

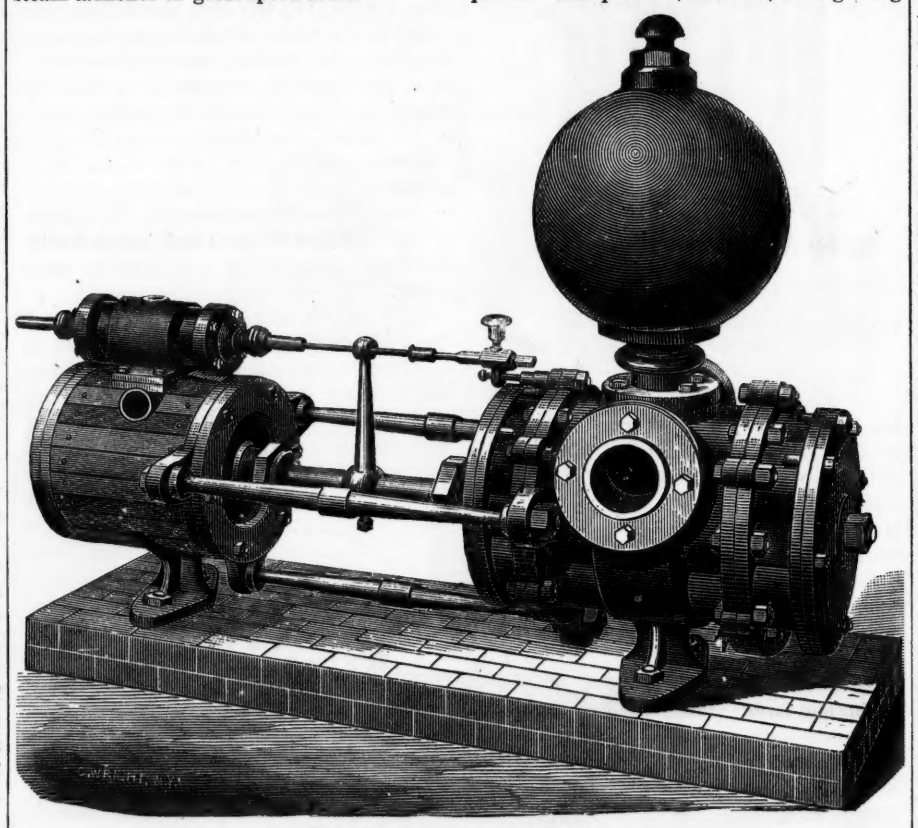
Both in boiler-making and ship-building the numerous instances where the use of steel has been discontinued have assisted in increasing the feeling of distrust in the material by those who have never even tried it. As is usual in such cases, the defects discovered have been much exaggerated, and so the prejudice has attained its present strength and dimensions.

From the present stand-point, the general future advance in the employment of steel plates has one of the greatest obstacles to contend against. The steel of to-day, which can be supplied in quantities suitable for boiler-making and ship-building, unfortunately inherits the prejudice that became attached to its name when uniformity in ductility and freedom from liability to temper could not be depended upon. It is now under the ban of suspicion, and a suspected material, like a suspected person, has not only its avowed enemies to contend against, but the susceptibilities of its employer. The maker or purchaser, who uses a suspected material, has not only the possible defects of the material itself to overcome, but also the feeling of anxiety and dread of the tone of triumph and superior wisdom assumed by his friends, whose appreciation of his well-directed efforts may possibly find its expression in the usual "Serve you right," or "I always told you how it would be." The consequence is that the failure of one steel plate in a hundred causes far more annoyance than the failure of one iron plate in fifty, even when the possible result of the failure would be no greater than in the former case. A man who uses iron plates and fails through the fault of the material, does so with the comfortable feeling of one of a majority, which is a very different feeling from that of one of a very small minority, who fails in a similar manner.

It is just one of these mistakes so often made to take for granted that iron plates are perfect in some of those qualities in which steel plates used to be found wanting. We have seen cases of best Yorkshire plates failing to a degree that would have condemned the use of steel plates in the same works for ever afterwards. Yet these best Yorkshire plates were meekly returned to the makers, without a word of protest, which it was known would have been useless, and replaced at the maker's convenience.

Perhaps no better instance can be given of the absurdity of the prejudice attached to the name of "steel" for plates, than the fact that some makers of steel had to invent new names for their material in order to find a sale for it. Take, for instance, the steel plates that were sold as "homogeneous metal" and "homogeneous iron," which have in many cases answered remarkably well where they would never have found a sale as "steel" plates. This practice, however, of disguising the name of the material, and saying it would work like iron, led to its being wrongly treated in more than one case, and consequently its use was not repeated. It would have been better for the future prospects of the material to have instructed the users as to the proper mode of working it in the boiler yard. A superior article usually requires more skillful treatment than an inferior one, and this certainly is the case with steel, although the skill required is different in kind rather than in degree.

A few years ago it was a question asked by those who believed in the ultimate general adoption of steel plates whether the general run of boiler-makers and others would have to be educated in the proper way of using the steel plates as then manufactured, or whether the makers of the plates could improve the properties and nature of their material so as to suit the skill and appliances available at ordinary boiler works and shipyards. This question appears to be in a fair way of being decided in the latter direction, as steel plates are being made more and more like the best iron plates, but without the defects inherent in the nature of iron plates as at present made from slabs.—*London Engineering.*



THE NATIONAL STEAM PUMP.

The National Steam Pump.

Among the numerous steam pumps now constructed for manufacturing, mining, and other purposes, the one represented here has received much attention for its simplicity, strength, and efficiency. The improvements that have been introduced from time to time, in order to render it valuable for general as well as specific requirements, are protected by numerous letters patent, and these improvements have been recognized by competent judges and experts who have carefully and critically examined its distinguishing features. It was awarded one of the highest medals at the Centennial Exposition, a silver medal and diploma at the Fair of the American Institute in 1876 and 1877, and also a silver medal at the New Jersey State Fair held during the same year.

The engraving is a perspective view of this pump in complete working order, and from this the exterior form and the general disposition of its mechanism will be readily comprehended.

The pump is one of the direct-acting kind. The centers of the steam cylinder and pump cylinder are in the same horizontal line, and the pump piston and pump plunger are connected by the same rod. The steam and pump cylinders are each secured to the foundation by a strongly-ribbed support, the base of which is well spread to allow the insertion of strong bolts, and both cylinders are connected together by three horizontal wrought iron brace rods, which keep the strain between the two in a direct and central line. The steam piston and pump plunger have packing rings, actuated by the pressure within their respective cylinders. One of the most important features is the mechanism of the valve gear, which consists of an auxiliary motor that operates the valve of the main engine when it is in an inoperative state—that is, when the main engine is at the point of reversing—and comprises the usual number of elements, namely, an auxiliary steam cylinder with its piston and valve. The main steam valve is the well known piston valve, performing with its opposite ends or faces, the function of the auxiliary piston, and the main valve stem the function of auxiliary valve in combination with the main valve chest, which also performs the office of an auxiliary cylinder.

This pump has no dead centers where it will stop. It will start from any part of the stroke without the use of any starting-bar or hand work to get it over the center; and one of the especial points of excellence which it possesses is, that it will work its steam valve with water, and will start even if the steam pipe is filled with water of condensation, as is very often the case in factories where the pump is not in continual use. In most pumps, where the main valve is operated by steam admitted by a small auxiliary valve, when moving at a high speed, the steam will not work the main valve quick enough, and consequently the piston strikes the head of the cylinder. This objection is entirely overcome in this pump. When running slowly, the steam operates the main valve; but if, in running rapidly, the steam should not operate the valve quickly enough, then the momentum of the main piston rod, which is connected direct with the valve rod, by means of a tapper, will reverse the valve, and thus change the direction of the piston before it can strike the cylinder head, so that at any speed there will invariably be a full port of steam for the return stroke before the piston reaches the end of the stroke.

The water passages are very large and ample, and in consequence of the valves being in the cylinder heads, it is possible to do away with all crooked and complicated water passages, thus reducing the loss of power caused by the friction of the water in turning short corners in crooked passages, and making the pump work with greater ease and economy.

In the water cylinder the valves and valve-seats are placed in the cylinder heads, and are easily removed or replaced without disturbing the air chamber, suction, or discharge pipe.

All parts are made interchangeable, so that in case of wear or accidental breakage duplicate parts can be supplied, without the trouble and annoyance of taking out the pump and sending it to the manufactory.

The best materials are used in the construction of these pumps. The piston rods, valves, valve-seats, and the linings in the water cylinder, are of the best composition metal.

Pumps of this description are constructed at the National Iron Works, New Brunswick, N. J., and for sale at the salesrooms of W. E. Kelly & Bro., 46 Courtlandt street, New York City.

RULE TO FIND THE HORSE-POWER OF STATIONARY ENGINES.—Multiply the area of the piston by the average pressure in lbs. per square inch. Multiply this product by the travel of the piston in feet per minute; divide by 33,000, this will give the horse-power.

Screw Plates and Dies.

The screw plates and dies herewith represented are made for tool, gun, model-makers' and jewelers' use. The screw plate is drop-forged in one piece from a good quality of bar-steel. The dies are made of the best tool steel.

The object of this invention is to provide a screw-plate in which the dies are securely held when in use, and which permits of their being rapidly and easily removed, or replaced when required.

The invention consists in applying hinged levers to recesses in the screw-plate, in such a manner that they are operated by the pressure of the ordinary set-screw upon the dies, to hold them firmly in the stock.

In the accompanying cut, Fig. 1, is a full view of the improved screw-plate with the parts arranged as in use.

In Fig. 2, is shown a sectional view, with the dies removed. The screw-plate A has in its centre a rectangular opening B, in the sides of which there is a groove C, E E are locking-levers, fitting in the groove C. F, is a pin moving in a hold in the side of the screw-plate, and is provided with a circular or wedge-shaped head for pressing upon the shorter arms of the levers E E. G, is a set-screw for holding the dies in place when in use.

To place the dies in the screw-plate, the set-screw, G, is loosened, and the pin F, pressed in against the levers E E, causing their longer arms to move back into groove C. The dies are then placed in the opening B, in the proper position, and pressed against the shorter arms of the levers E E, forcing the longer ones into the slots C, in the side of the dies, by means of the set-screw G, which holds the dies firmly in place.

To remove the dies, the screw G, is loosened and the pins F, pressed in, forcing the arms of the levers out of the slots C, and allowing the dies to be easily taken out.

Fig. 3, represents a pair of dies for holding taps, used in the screw-plate, in place of the thread dies. Thus making a very convenient tap-wrench, saving the necessity of an extra wrench, as it combines the two.

Fig. 4, represents a pair of thread-cutting dies. This improvement is the invention of C. E. Billings, Patented July 11th, 1876.

For further particulars, apply to The Billings & Spencer Co., Hartford, Conn., or at the Headquarters, H. Prentiss and Company, 14 Dey street, New York City.

FIG. 2

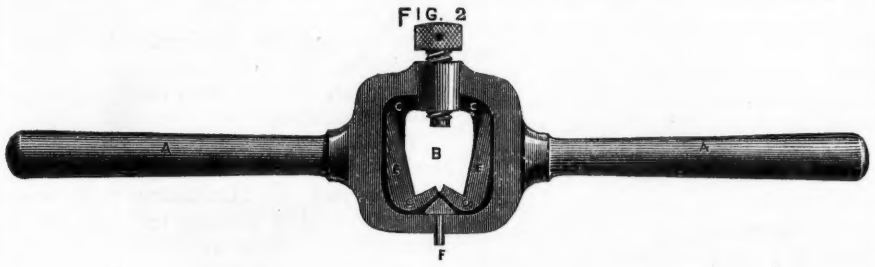


FIG 3

FIG. 4

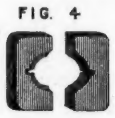
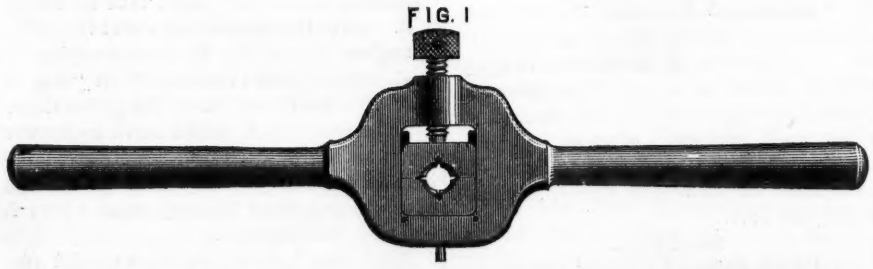


FIG. 1



"Metaline."

Paper read at the monthly meeting of the London Association of Foremen Engineers, 2d March, 1878.

JOSEPH NEWTON, ESQ., C. E., IN THE CHAIR.

By A. H. BATEMAN, F. C. S.

The great natural industries of the British Isles are those of coal and iron. The former is solely used as fuel, and decomposed into its constituent gases to enable the various manufacturing processes to be carried on, and for the production of artificial heat for personal comfort; the latter undergoes most varied and interesting manipulation. An elaborate and really delicate chemical process, although on a vast scale, eliminates extraneous matter, or what has been well described as "dirt"—*i. e.*, "matter in the wrong place." The metal when produced in an approximately pure condition is handed over to an entirely different class of workers, and its value increases rapidly as it passes through various hands until, in the finished steam-engine or war-ship, it reaches its culmination as the product of both brain and hand power.

Numerous are the details of construction and mechanism necessary in each branch of metal manufacture, and it may be doubted whether the larger proportion of metal-workers are not engaged in making tools for the smaller number to use, rather than the majority employed in actual production of articles for the ultimate use of the consumer.

How many monuments of antiquity and many early engineering works were carried out is still a mystery, and it may, we fear, be said, that having regard to the crudeness of the mechanical assistance, then, possible, our forefathers have in many respects surpassed the present generation. Doubtless *time* was an element to them of far less moment than in this age of high pressure both of steam and of brain, and this must be our consolation at a moment when such a commotion is caused by the mere moving and re-erecting of an old monolith—only one of many, apparently, readily handled by our predecessors in the engineering profession of what we term "the dark ages."

The introduction of the steam-engine—that most patient and economical of servants—of course wrought an entire revolution in our workshops, and mechanical aids then became realized facts that had till then been but dreams in the vision of the most far-seeing of their age and generation. The bulk of hand-work is of necessity of a reciprocating character—up and down, backwards and forwards—that of the steam-engine (in its actual application) is rotary, to which form of power the first movement of the piston is immediately converted. A continuous rotary action admits clearly of a new class of mechanical tools, and the first result of the introduction of steam-power is to provide a long metal shaft, which is kept in constant rotary movement, and from which power is re-conveyed to the numerous and various other machines requiring it.

Now it is one thing to make a machine, it is another to use it properly. A good machine must not only do its stated work when it is first completed, but it must *continue to do it*—a point oftentimes sadly overlooked now-a-days. The old clumsy-looking clocks and watches of our forefathers are many of them to-day doing their duty better than very recently constructed specimens of the "cheap and nasty" order, and due regard must be paid to this necessity of *durability* in the building of every machine.

It is not so long ago that men were seeking both the philosopher's stone and perpetual motion, and even now the latter phantom flits across our path now and again.

Only *one* law or fact requires to be eliminated from our vocabulary to permit of this consummation being attained; that word is *friction*, a well-known word, a well-known fact! How many of us would be glad to see it expunged, and feel disposed to say with the old lady who was complaining of the price of her tea, and said she would "excuse the duty," that we could "excuse the friction!"

But this is not to be; we can only reduce it to a minimum, and many indeed are the ways and means to this desirable end.

Friction between two pieces of wood will cause fire; this was probably the earliest mode of obtaining what was formerly regarded as one of the four "elements," and short of actual fire there is every possible degree of heat, injury, and drag.

Trundle a wheelbarrow, with its single wheel, a mile without grease on its axle, and three miles with proper lubrication, and see which tires you the most! This is a homely but valuable exposition of the practical effect of friction. The first result is *loss of power*. Another, and in some cases even more important, result of friction is *injury to the moving parts;* both of these effects, unless kept down to the lowest point, are fatal to good working. The first step in the construction of moving machinery is so to plan it as to avoid *unnecessary friction*—*i. e.*, to let the work desired be done with as little waste of power as possible. This done, the *necessary* friction has to be dealt with. This is done partly by the maker, partly by the user.

The maker *fits* his moving parts with great accuracy, allowing them to just move and no more; all unnecessary play being avoided for the double object of avoiding knocking and keeping out extraneous matter, dirt, dust, refuse, &c. He also exercises care in the *material* of the moving parts. It is a well-known fact that corresponding substances exercise more cohesive or adhesive power than differing materials; therefore in moving surfaces two similar metals are avoided. By far the commonest bearing surface is that afforded by steel or iron moving parts, working on or in a cylinder or sheet of brass. Cast-iron works well on wrought-iron; any metal works well on an alloyed compound of tin, copper, lead, antimony, mercury, all or some being combined in varying proportions, and known as Babbitt metal, Kingston metal, white brass, &c. Lately a new and very superior bearing surface has made its appearance under the name of phosphor bronze. Each of these has its own special merits and adaptability for specific purposes. But the greatest skill in fitting, and judgment in choice of materials, will not insure satisfactory performance of the moving parts of a machine if the *user* does not do his share and attend to his own duties. However perfect are the bearing surfaces they must be some how *kept apart* if we are to reduce friction to a minimum. For this purpose a lubricant is used, generally oil or grease, the object of which is to provide an extremely fine skin of lubricative material between the two parts of the moving surfaces.

All practical men will at once acknowledge the difficulty of finding either an oil or grease that will answer its purpose equally well for heavy or light bearings, fast or slow speeds, hot or cold weather. Either constant change and extreme complication is necessitated, or a large proportion of the work is very badly done. As a matter of fact the latter is the case.

Few managers and foremen, and fewer masters, have a real practical knowledge of oils; we all use what some one else recommends, and most of us try to avail ourselves of one supply for all sorts of machines. As a matter of course some of these are badly, while others are well served. A certain amount of rule of thumb variation is in some cases made for weather, by thinning down an oil in winter and using it pure in summer, but in the glorious uncertainty of the English climate this is not nearly enough.

It may probably be accepted that the majority of English factories of all kinds have some reserve of power—*i. e.*, have power to spare; therefore the difference between a good and a bad oil is not so readily felt; but take a case where a proprietor has only just enough power to drive his machinery, and let him oil with bad oil, and he will find that he simply cannot drive at all. Again, in large spinning-mills, for instance, where there may be thousands and thousands of spindles, what is the result of a drag of very slight amount in each? Take the moderate estimate of 1 lb. drag from the thick and gummy oil on each of 20,000 spindles, and you have the astonishing result of an *additional* driving power required of no less than 10 *tons*. What wonder that on a Monday morning in cold weather it is a difficult thing to start the machinery at all, and that this ten minutes is the harvest-time of the belt-makers?

There is a perennial outcry about the diminution in the supply of coal. Be this founded on fact or not, it is a sin and a shame to waste fuel; yet this is being done to the tune of hundreds of thousands of tons annually by badly-constructed furnaces, and improper oil. Too much care, therefore, cannot be taken with the necessary lubricant on the ground of power. A thin oil tends to run away too fast, and not only exhausts the source of supply rapidly, but makes a great mess, and attracts and holds dirt; a thick oil is not sure to flow fast enough; greases are under the same possible objection, and, as we have seen, temperature has an important mechanical effect on the degree of fluidity of oils and greases. It will be at once admitted that it cannot be good to require a bearing to get hot before the lubricant begins to flow. Another point must also be carefully attended to—not to permit the shaft or spindle to itself suffer while the bearing surface remains intact. This is a matter that does not always receive the attention it deserves.

It is a well-known fact that when hard steel and brass work together, it is invariably the *former* that suffers! Take the steel pallets of a clock, you will find notches cut in each by the comparatively soft brass of the scape-wheel. If either is to wear, it is better, because cheaper and easier placed, that the bearing surface should suffer than the moving one. Examine a well-finished bearing—whether steel or brass—under a moderate microscopic power, and you will find it to be composed of a number of small projecting points with hollows between. Put two such surfaces together, without the skin of oil to separate them, and you will have these points scraping one another off; these particles will chiefly adhere, and gathering as they do like the snow-ball, you have the well-known operation called "cutting," more familiar than pleasant. Disregard this, and continue to run, and you are landed in a still more unpleasant region of "firing," When this happens you *must* stop! A certain amount of running, with a good lubricant, will bring bearing surfaces to a far better face than they can have given them by the most skillful mechanical labor; this is why new machinery always runs better after a time than at first.

But when all is said and done what does oil or grease *really do?* Interposes a thin film between two comparatively rough surfaces, and *so long as it keeps them apart* prevents heat and much of the friction. Oil does nothing, or little, in the direction of improving the surfaces. They do this for themselves, oil preventing injury by cutting (generally) during the process. Can nothing be done to cause the lubricants to *help* the acquisition of so true a surface as to reduce materially the number of opposing points of

which we have spoken, and do away with the tendency and disposition to cut?

Experiments have long been tried in this direction, and a very considerable degree of success has been attained. The theory is a new one, on which the whole system hangs. Instead of keeping the rough surfaces apart, the new plan says, "*Smooth off the rough points and produce smooth surfaces, then contact will not injure, but positively do good, as it will keep out extraneous matter.*" The actual substances used to attain these ends may be widely varied. Metallic oxides and other substances reduced to an impalpable powder are efficacious, but the principle being accepted, and the right form and mode of application adopted, there is a large field of suitable substances to draw upon. Careful experiment following upon elaborate theorizing has enabled Dr. Stuart Gwynn, of New York (the inventor of the centrifugal pump), to produce a powder so fine as to be passed through a sieve of 15,000 meshes to the square inch, which when pressed by enormous hydraulic pressure into small steel moulds produces cylinders or plugs of the general size of $\frac{1}{4}'' \times \frac{1}{4}'$, varying to 5/6″ and 1/8″, and 3/16″. It has been found that the inherent strength of this material is not enough to carry any but light weights, therefore a solid bearing of this substance is inadmissible, but it is inserted into the ordinary brasses, holes being accurately drilled for the purpose—generally about 10 to the square inch. The whole bearing surface is well covered by holes plugged as described, these holes being so drilled as to break joint and protect the entire brass. The protecting ends of the plugs are cut or filed off roughly. A few hours' running completes the fitting and gives a perfectly true bearing surface, the plugs once down to the level of the brass wearing no more. The impalpable powder of which the plugs are composed, wearing away, polishes off the asperities and points of brass and iron, *the two surfaces come together*, there is nothing rough to tear, catch, or "fire," and so accurate a fit is insured as that no dust, dirt, *débris* or other extraneous substance can interpose itself and cause cutting of the moving and fixed parts.

The idea is so new, so opposed to all preconceived ideas, that the natural tendency is to say, "Too good to be true."* But "facts are stubborn things;" and next Monday morning there will be running, to my personal knowledge, in London alone—

Main shafting	3½″	at	150	rev.	per min.
Counter do.	2⅞	"	350	"	"
Do.	3	"	250	"	"
Do.	1½	"	450	"	"
Main Do.	3	"	200	"	"
Lathe head (abt.)	1¼	"	2000	"	"
Loose pulleys at	450 and 700			"	"

—all having been at work from one to nine months, and never having had during that time one single drop of oil or other lubricant. In other parts of the kingdom there are main shafting 5″ and calender rolls with 10 tons and more pressure—printing-machines, spinning-frames, circular saw spindles, woodworking machinery, sewing machines, cranks, bicycles, &c. The large drawings show the mode of application of metaline plugs. The first is an ordinary *half brass* for Plummer block, then *a loose pulley* split with divided brass bush; two forms of *divided bushes*, one plain, one with flange. A *tube* for solid pulley; this is drilled right through from the outside and the plugs inserted, the inside ends being rimed off after the tube is inserted in the hole of the pulley. A *slide* for various purposes.

The proper form of drill, and the flat-bottomed hole it makes, is also shown. A pointed hole is unsuitable, as it does not present a proper bearing for the bottom of the plug of metaline. On the table are samples of the brasses showing the three parts of the process, drilling, fitting, and paring off; also specimens of the drills used, a pair of brasses that have been running in my own shop nine months, and a loose pulley, taken down today for the first time after nine months running, at 400 to 450 revolutions per minute, ten hours a day, with at one drop of oil. The shaft is unaffected where this pulley has run; there are wire gauges of that part, and three inches off; showing no appreciable difference.

I can mention instances where, after such running as with oil would have necessitated new brasses, these latter are positively unaffected. It is evident that should what is claimed for metaline be borne out by further experience, it cannot fail to be a most important invention. It is not likely it will entirely supersede oil in all directions any more than solid emery wheels will entirely supersede hand files; but for loose pulleys, pulley sheaves, inaccessible main shafting, machines and factories where valuable fabrics are exposed to injury from oil-drippings, &c. it must surely be rapidly introduced.

The first cost, about 6d. per inch of surface, may appear high, but the saving in oil will not take long to cover that, and if largely introduced there would be a further saving in men's time oiling and cleaning. There is also another important aspect, the avoidance of fire from spontaneous combustion of oily waste. Already insurance offices have expressed their approval of the invention, and willingness to reduce their premiums for factories where it is employed. In America it appears to be gaining ground rapidly, and a remarkable list of applications has recently been sent me.

In conclusion, if the attention that this new system is exciting, has no other object than to direct notice to the question of lubrication, and induce more careful regard thereto, it will have done good work; but I cannot but believe that enough has been shown, not only in the theoretical aspect, but in practical results, to insure its gradual and steady introduction into many, at least, of our factories and engineers' workshops.

The day for prejudice and objection to any new thing has passed away, and if Old England would hold her own as producer of the cheapest, and above all, the best machinery in the world, her sons must avail themselves of every invention tending to increase efficiency and reduce the cost of production. We may wish that more of the numerous clever mechanical inventions of late years had emanated from this side of the Atlantic; but, after all, we need not hesitate to adopt what is offered to us by "Our American Cousin," resting secure that for right down honest work, perfection of finish and durability, it will take a good man to equal—let alone beat—the intelligent British mechanic of the year 1878.

DISCUSSION.

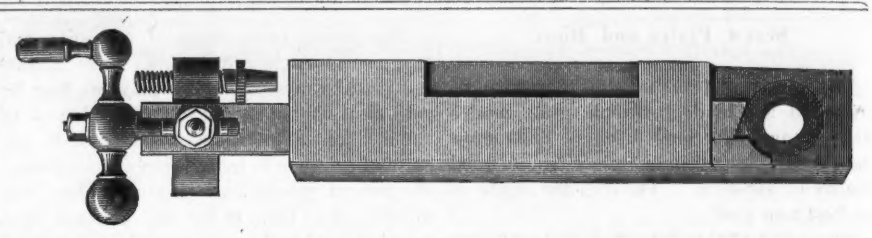
Mr. Cassels endorsed some of the particular results given in the paper. He, about three years ago, visited a paper-mill in Birmingham, the proprietor of which had tried the metaline in a 12-horse power engine, the patentee operating with the metaline upon the crank-pin. The engine had been at work for a week when Mr. Cassels visited it, and upon the fitter taking off the strap and taking out the brasses and wiping the bearing all round, there was not the slightest particle of dirt to be seen. He believed that the engine was still at work without a particle of oil, and no signs of wearing on the bearing.

Mr. Coates wished to know what amount of pressure the material would withstand, and what extreme speed of bearings would answer and give good results?

Mr. Bragg asked if the metaline had ever been tried on the slide surfaces of engines?

Mr. Robert Low, although not having had much practical experience of the working of metaline, said that two months ago Mr. Bateman took some brasses from a lathe and metalined the bearings, and he (Mr. Low) had put them to work on a spindle running 2,000 revolutions per minute, which, of course, involved a great pressure. With the exception of meal hours the lathe had been running, without intermission, since it was started. In order to give an independent testimony he would read a report which he had requested the foreman to send to him. The report was as follows:

"With reference to the headstock fitted with metalined bearings, it was started at 4:30 a. m. on the 14th of January last, and



has been running continuously, with the exception of two hours for meals, making 1,900 odd revolutions per minute, for nine hours per day, or a total of 320 hours, up to 4.30 p. m. yesterday (March 1st). That with the exception of a slight heating the first quarter of an hour, it has been running perfectly cool without lubrication of any description. With respect to the wear there is little to be observed, but not more than would occur in any headstock fitted with ordinary bearings running under the same conditions with oil. With reference to its adaptability to any plant, independent of its economy and general cleanliness, I would especially recommend its adoption for fuse-making machinery, on account of the wood fuses having to be thrown away on being sapped with the oil—a circumstance apt to occur. I would also suggest the re-lining of loose pulleys, for which I think it is specially adapted."

Mr. Low added that the bearing was running cooler than any bearing on the plant supplied with the best lubricating that they could get.

Mr. Cartmel, Mr. Macdonald, Mr. Sykes, Mr. Gibbon, Mr. Stabler, and other members also spoke, some of them testifying to the value of metaline.

Mr. Bateman, in reply, said that he had been told on good authority that in the neighborhood of Manchester there were several calenders working under metalined bearings, and it was well known that they worked under very high pressure, occasionally even at a total of 30 or 40 tons. As to speed, in America they spoke of 16,000 revolutions per minute; but he knew of 3,000 revolutions in England. As to how metaline lubricated, he replied that it really was not a lubricant—friction was by it reduced to a minimum, so that they need take no notice of it. As to the point raised about the slides of engines, he said that there were engines at work which were metalined from "top to toe," with the exception of the piston-rings. A statement which would serve to answer many queries was, that the use of the metaline had served to do away with the increase of machinery power in many cases where it had been contemplated.

After some further remarks, a cordial vote of thanks was proposed by Mr. Robert Vinicombe, and seconded by Mr. Ronald, in putting which

The President said that as to the character of metaline, time alone would prove its real value; but so far as the evidence given by the speakers went, it appeared likely that it would be a useful accessory to the engineer and mechanic generally.

The vote was carried, and Mr. Bateman thanked the meeting for the reception accorded him.

The meeting then separated.

Reprinted from the "Foreman Engineer and Draughtsman" Journal, 1st April, 1878.

*Metaline has been in use for the past ten years. It is secured by 22 patents in the United States.

AVERAGE PROPORTION OF VARIOUS PARTS OF ENGINES.—*Steam Pipe* should be ¼ the diameter of cylinder, but varies on large engines. *Exhaust Pipe* should be ⅛ the diameter of cylinder. *Piston Rod* should be ⅛ the diameter of cylinder if of iron, and smaller if of steel. For high speeds, steel piston rods are the best. *Steam Ports* vary according to speeds, from $\frac{1}{16}$ to $\frac{1}{10}$ the area of piston. *Safety Valves* should possess an area of ½ square inch of surface for every foot of grate surface, and should be constructed with loose vibratory stems, for the reason that they are not so liable to get out of order as those with rigid stems.

Torrance Merriam & Co., Troy, write us that they are "now much crowded with work.

Hazelton's Combination Turning and Screw Tool.

Every practical machinist will readily appreciate the usefulness and convenience of this invention, which effectually does away with the clumsy back-rest that often takes up more room than can be well spared for its use. Being clamped in the tool-post the same as any ordinary turning-tool, it is almost instantly ready to use. The inventor devised it for a lathe in his own shop, where there was no back-rest fitted, and has since used nothing else for working long shafts and screws. We believe that this tool will become an indispensable fixture wherever introduced. The principal points of advantage are as follows:

1st. In working the largest diameters the rest will admit, the cutting-tool has its strongest support.

2d. In cutting screws, especially square threads, the hardened collars throw down the burr of the first few cuts, which is in turn cut away by the thread-tool, leaving a clean, square corner and polished face to the thread when finished. They particularly commend it for cutting feed and other long screws, as it cannot fail to produce smooth and accurate work, and will take the heaviest cut we have ever seen.

3d. For cutting up rods or tubing this device is simply perfect; no breaking of tools, no catching and jumping, but it cuts right into the centre, with hardly a sound. It may be used to advantage in the engine lathe for making collars, by having a drill chuck in the bailstock.

4th. If, when in use, the edge of the cutter becomes dull, by slacking the clamp-nut at the rear end, the cutter may be slid out, sharpened, and put back exactly as before; saving time used in setting the ordinary screw-tool.

5th. Any shaped tool may be used in the frames, as its peculiar construction allows the use of a small size of steel, which is, notwithstanding, just as stiff as a large forged tool.

It will be seen in the cut, that a feed-screw and stop are provided, so that the ordinary cross feed-screw of the carriage is simply used in combination with the elevating-screw, to bring the rest and work concentric. An adjustable V rest is also provided for turning and sizing. Hardened collars are furnished with the No. 1, or small size, from ⅛ to ¾ inch; also one dozen blanks for cutters; also extra frame for left-hand work. The yoke, feed-screw and stop fit the left-hand frame by simply reversing the same. The larger sizes are fitted up in the same manner as No. 1. Collars are supplied with holes corresponding to standard reamers, but wire sizes being more convenient for some, may be had if desired, or both standards at a moderate advance. Stone & Hazelton, 13 Bowker St., Boston, are the manufacturers.

WRITING INSCRIPTIONS ON METALS.—Take ½ lb. of nitric acid and 1 oz. of muriatic acid. Mix, shake well together and it is ready for use. Cover the place you wish to mark with melted beeswax; when cold, write your inscription plainly in the wax clear to the metal with a sharp instrument; then apply the mixed acids with a feather, carefully filling each letter. Let it remain from 1 to 10 minutes, according to the appearance desired; then throw on water, which stops the process and removes the wax.

TO PREVENT IRON RUSTING.—Give it a coat of linseed oil and whiting mixed together in the form of paste. It is easily removed and will preserve iron from rusting for years.

The Vitrified Emery Wheel.

This wheel is formed by combining emery with small quantities of abraiding material which will make a flux in the fire. It is then subjected to a degree of heat which will melt the flux without injuring the emery.

There is no glutinous or soft metalic substances in these wheels to glatze them over and lessen their cutting qualities.

The substances used as a flux, when in a melted state, fill all the interstices between the particles of emery, and it is claimed, make the wheel stronger than it could be put together by pressure. The flux, as it cools, contracts a little, leaving small cells or pores all through the wheel, so that water will pass freely through. The Vitrified Wheel and Emery Co., Westfield, Mass., availing themselves of the benefits arising from this peculiarity of their wheel, have introduced a Patent Central Water Supply, represented in the accompanying cut, by which water is introduced into the center of the wheel, and by the centrifugal force thrown to the surface.

By this means tools of all kinds can be ground without drawing the temper in the least. Also the emery dust from wheels, so destructive to machinery, may all be prevented. The emery wheel, with this new and wonderful invention, is designed to take the place of grindstones wherever the former can be employed.

The following description will aid in understanding the construction of the water supply:

A represents the emery wheel. B B the flanges. C C the arbor. D D a brass tube inserted into the arbor to admit the water. E is a pipe that conducts water to the tube, and F, a small tank with a sponge in it to filter the water. G a nut to hold the wheel on the arbor. H a nut to hold the loose collar. I I the small tubes running through the large tube into the chambers.

Not a particle of the matter contained in the Vitrified Wheel can be dissolved in water; therefore it can be run in water as well as dry. This wheel being burned can be made of every degree of hardness that can be desired and can be adapted to every kind of work.

The Vitrified Wheel and Emery Co., under a new patent, by the use of a very strong flux, make a very hard wheel called the Iron Age.

It is nearly all emery, and is well adapted to grinding rough castings, and will do the hardest kind of work. They also make rubstones about the size of a brick for cleaning castings, slip-stones for polishing, and whetstones for scythes.

Brazing.

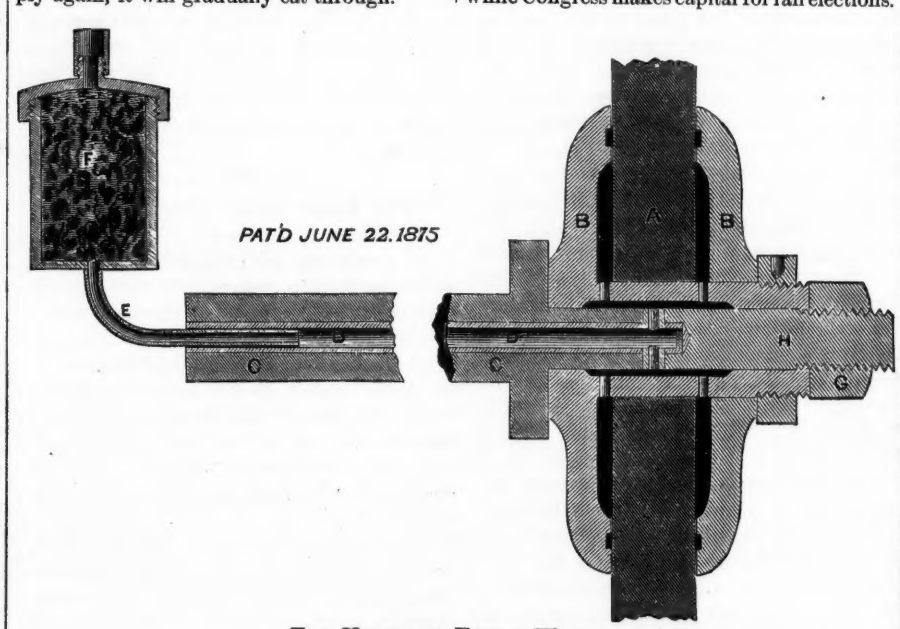
In brazing brass, copper, wrought iron and steel, thoroughly clean the metal at and near the joint to be brazed by scraping or filing. Be sure and fit the edges close together. If great strength is required lap the edges by each other about a quarter of an inch. A good plan is to rivet the edges together to hold them in position. Next place the brazing material along the joint. Take borax finely powdered, wet it with clean water, and place a small quantity along the seam. Put the article over the forge with a charcoal fire or common coal, after it is well burnt down, with the joint down. Heat it slowly and evenly, holding it an inch or so above the coal. Hold the article in one hand and a small iron rod in the other. If the brazing material should be moved away from the joint by the borax place it back before it melts. When it is all melted rap the article lightly with a rod which will help it to flow all through the joint. Remove it from the fire as soon as all the brazing is melted and hold it horizontally until it cools so it will not run. If the article is brass or copper it should then be plunged into cold water, but if iron or steel, place it where it will cool slowly. For brazing brass use silver; for copper, iron or steel, use spelter or thin strips of sheet brass.

We have received a "Catalogue for Advertisers," from C. K. Hammitt's Advertising Agency, 206 Broadway, New York. It gives classified lists and descriptions of the principal industrial newspapers throughout the United States.

TO MAKE A BORING ARBOR AND TOOL THAT WILL NOT CHATTER.—Boring tools, when used in small arbors, are always liable to chatter and make a rough hole. To prevent this, the tool should be turned in a lathe, while in its position in the arbor, upon the circle of the size of the hole to be bored, and the bearing lengthwise of the arbor, should be only as wide as the feed of the lathe; for if the bearing of a tool is on the face, the more it will chatter.

TO CLEAN AND POLISH BRASS.—Oil of vitriol, 1 oz.; sweet oil, ½ gill; pulverized rotten stone, 1 gill; rain water, 1½ pts.; mix all and shake as used. Apply with a rag and polish with buckskin or all woolen. Rotten stone, followed by Paris white and rough is very good also.

TO DRILL HARDENED STEEL.—Cover your steel with melted beeswax, when coated and cold, make a hole in the wax with a fine pointed needle or other article the size of hole you require, put a drop of strong nitric acid upon it, after an hour rinse off, and apply again, it will gradually eat through.



THE VITRIFIED EMERY WHEEL.

VELOCITY OF WHEELS, PULLEYS, DRUMS, &c.—When wheels are applied to communicate motion from one part of a machine to another, their teeth act alternately on each other; consequently, if one wheel contains 60 teeth and another 20 teeth, the one containing 20 teeth will make 3 revolutions while the other makes but 1; and if drums or pulleys are taken in place of wheels, the effect will be the same; because their circumferences, describing equal spaces, render their revolutions unequal; from this the rule is derived, namely:

Multiply the velocity of the driver by the number of teeth it contains, and divide by the velocity of the driven. The quotient will be the number of teeth it ought to contain; or, multiply the velocity of the driver by its diameter, and divide by the velocity of the driven.

Example 1. If a wheel that contains 75 teeth makes 16 revolutions per miuute, required the number of teeth in another, to work into and make 24 revolutions in the same time. According to rule, you multiply 16 by 75, and divide the product, which is 1200, by 24, and you have the answer, 50 teeth.

Example 2. Suppose a drum, 30 inches in diameter, to make 20 revolutions per minute, required the diameter of another to make 60 revolutions per minute. According to rule, you multiply 20 by 30, and divide the product, which is 600, by 60, and you have the answer, 10 inches.

Example 3. A wheel 64 inches in diameter, and making 42 revolutions per minute, is to give motion to a shaft at the rate of 77 revolutions in the same time; find the diameter of a wheel suitable for that purpose. According to rule, multiply 42 by 64, and divide the product, which is 2688, by 77, and you will have for the answer, 35 inches nearly.

From a Letter to the Railroad Gazette.

In my opinion, if more attention was paid to power and stiffness and good wearing, long bearings in the construction of machinists' tools, and less to ornamental gingerbread flourishes and nonsensical sharp corners, they would give better satisfaction in the long run.

Take a general run of work for instance about a locomotive, such as driving-wheel axles, boxes, eccentrics and straps, crank-pins, etc. The stiff and powerful lathe for boring and turning, with heavy cuts and a coarse feed, would beat the slender, highly polished, metal-stinted, belt-fed light carriage and small tool-holder rival all to smash.

This is merely a matter of opinion, however. There are many who think otherwise. There is a great diversity of opinion about lathe shears or bearers. All English lathe beds are flat and gibbed down. American tools generally have too narrow Vs on the top. There are different opinions about friction.

A VETERAN.

Business interests of the country suffer, while Congress makes capital for fall elections.

Defective Engines.

Thousands of old, wasteful engines are in use, and even very many new ones are constructed on such defective principles that the consumption of fuel in connection with them is very excessive. According to the report of Mr. Hiller, chief engineer of the British Boiler Insurance Co., the following are the principal causes of the waste of fuel, etc.: Engines too small requiring the steam the whole length of the stroke; others, on the contrary, being too large, and rendering its economical expansion impossible; non-condensing engines connected with low pressure boilers, or fitted with simple valves with no lap on the steam ports and no expansion of the steam; others with lap on the exhaust port. In many, both non-condensing and condensing, etc., the throttling action of the governor prevented free admission of the steam. It is impossible to work economically with such an arrangement.

Other non-condensing engines were working at too slow a speed. Some condensing engines had no cut-off gear, or the valves were improperly adjusted, the steam being exhausted into the condenser at a high pressure vitiating the vacuum and causing overloading of the air pump. Others, although provided with good cut-off gear, were unsatisfactory through want of supervision, the attendants rendering it almost useless by faulty adjustment of the governor, etc. In compound engines, the cylinders, in some instances, were small-proportioned, the condensing cylinder frequently being too small, the steam pressure not being sufficiently reduced at the point of exhaust. In others, owing to the low pressure in the boilers or defective arrangement of the governor valve, the initial pressures were too low. Regular and careful examination of all valves, pistons, etc., is essential to insure economical working. He adds that it is a mistake to have compound connected with weak low pressure boilers.

Standard Gauges and Tools for Accurate Measurements.

BY JOHN J. GRANT.

Tools for accurate measurements are coming into more general use every year, and workmen are fast learning the difference between perfect and approximate sizes. The idea of having a set of standard gauges in all machine shops and working by them cannot be enlarged upon too much. No two shops not having such a set of standard guages can make work that will interchange.

The time is fast going by for using the expressions "plump" and "large" inch, thanks to "standard" gauges and a more general use of the vernier callipers.

There has probably been as much, or more, improvement in tools or instruments for measuring as any one branch of mechanics tools. Only a few years ago the vernier callipers was comparatively unknown, and working to the $\frac{1}{1000}$ part of an inch a myth; now, in almost every machine shop, the vernier is a common tool and everything of any importance is measured by it. Standard gauges in the form of cylinders for both out and inside measurement have been in use in some of the larger and better equipped shops, but have not come into general use on account of their cost.

They are made now at more reasonable prices, and should take their place in every shop, seeing that they will be found to more than pay for their cost in the time saved in working up accurate sizes.

The gauges should never be allowed to go into the shop to be used in common; but be kept for reference, and for setting slide gauges. Used in this way they will last a lifetime and retain their accuracy.

Screw thread gauges are now made adjustable, and can be used for fitting threaded work, as they can be closed together even when worn; and in connection with the screw thread gauge is the V or angular guage of 60° for grinding threading tools and also for turning lathe centers. The practice of grinding threading tools and turning off lathe centers without this gauge—and by the eye only—should never be allowed.

"Snap," or calliper gauges are now made very cheap and accurate, one variety having both out and inside measurents. Such tools will pay for their first cost in a year.

The idea of making everything to a standard measure should be encouraged in every way possible. The advantage of interchangeable work can hardly be counted in dollars and cents; for instance, imagine every maker of gas pipe to have his own standard of sizes and threads; why, the confusion at the Tower of Babel was nothing compared to what it would be if this "no standard" system were to prevail. It would be but little worse than the loose way in which the general run of shops make some of their work—the system of making bolts and nuts for instance.

Now, let us all take hold with a "long pull and a strong pull," and make everything to the standard adopted by the United States Government.

In the matter of screw threads the Government standard may not agree with the ideas of every one; but it certainly is the duty of every one owning or having charge of a machine shop to adopt the standards and so help the ball roll which will in time benefit himself as much as his neighbor.

STEAM PACKING.—Many varieties of packing are used, such as metallic packing, packing composed of a mixture of duck, paper and tallow in proper proportions, soapstone and loose twisted cotton coils, asbestos, jute, &c. An excellent packing is composed of hemp in long, loosely twisted coils, well saturated with melted grease or tallow, with as much pulverized black lead as it will absorb. Packing is always applied with the best effect when the parts of the engine are cold, and its efficiency is promoted by soaking it in beeswax and tallow previous to use.

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☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *We are not engaged in procuring patent rights, or in selling machinery; nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draughtsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

NEW YORK, MAY, 1878.

Small Power Motors.

There is, perhaps, no branch of practical mechanics in which our country excels Europe more than in the production and adaptation of small power, self-contained, portable and semi-portable engines. We include in the term "engines" all motors for furnishing power, whether driven by steam, hot air, compressed air, electricity, gas, or liquids. Hot air engines, with but two or three exceptions, have met with meagre success, though the exceptions are good enough to warrant greater endeavors and steady progress towards perfection. The perfected hot air engine, for limited power, would stand virtually without a rival were it to develop an economy equal to that of an average steam engine. Whether this is possible remains to be seen, for we do not agree with those who claim that its possible economy has been fully demonstrated. The elements of absolute safety, ease of management, and occupancy of small space, are not to be lightly estimated. Engines driven by compressed air are adapted only to peculiar situations, where the use of steam would be objectionable. As the original power is not obtained from compressed air, they can scarcely be considered with self-contained engines. Inasmuch as compressed air is only power stored up for use, the economy of an engine driven by this force cannot be determined apart from the special work it is designed to accomplish. Reduced to an abstract question of economy, it is difficult to see where there is anything gained by creating a reservoir of power and afterwards letting it out as required. For diminutive power electro-motors have appeared from time to time, and as regularly disappeared from public view. Their principal use seems to be to attract admiring crowds at the autumn industrial exhibitions, and to carry away (along with the plaudits of visitors) silver and bronze medals and showy diplomas, setting forth their wonderful merits. Electro-motors have been made to develop more than a horse-power, though we have never seen one work well above a dog-power—indeed, they appear to best advantage at less than a cat-power. Still there is a great future looming up before electricity, and it may be successfully adapted to motive power. Gas engines are employed for pumping water, for which they seem to be well adapted. Hydraulic motors (of a portable kind) work well for certain purposes, especially where a sufficient force of water is obtained from street mains; when considerable power is required the regular water-wheel must be used. No motor has yet appeared to supersede the steam engine either for small or large power, or general purposes. Rotary steam engines consume too much steam in proportion to the power obtained, though some of them have given good satisfaction for hoisting. It is upon engines, vertical and horizontal, with boilers attached, from one to ten-horse power, that Yankee ingenuity has found a most fertile field to display itself. So many different engines of this class have been before the public within the last few years, that it is almost impossible for one to "keep posted" in regard to them. Competition is so strong that fully as much talent is required to sell these ready-made motors as to design and manufacture them. The wonderful economy, strength and durability of the "Excelsior" must be shown to be inferior to that of the "Eureka," and that to the "Acme," the "Little Hercules," the "Ne Plus Ultra," the "Snorter," &c., to the end of the list. This competition has gone so far, particularly in making them low-priced, that the number of trashy engines and boilers disposed of every year is positively discouraging to the builders of first-class work, who cannot sell their productions as cheaply as their careless rivals. The cry is for something *very cheap*, and it is generally satisfied with something both *cheap and nasty*. We hear of instances where the boilers of some of these popular low-priced engines have completely given way in three months' use, and other instances where the whole motor has been condemned and sent to the junk shop in less than a year from the time of starting. Why are so many worthless engines sold? The reason is, that such is the diversity of industries requiring small power, not one purchaser in a score has any practical knowledge of engineering, and instead of consulting some reliable party that has such knowledge, consults the price as the chief factor, and becomes inspired by the rosy guarantees and representations of the agent. Few men are willing to admit their ignorance of anything they are about to purchase, and the seller takes advantage of this fact, puts forth a little flattery, and secures his customer. Without, doubt we produce both the best and the poorest small power engines in the world.

Model Machine Shops.

The difference in appearance of various machine shops we have occasion to visit is both striking and suggestive to any outside observer. While neatness and system reigns in one we find half a dozen that can lay no just claim to either the one or the other. It certainly does not convey a favorable impression to a visitor to see floors and machinery bedaubed with oil and dirt, little mounds of chips and turnings left to accumulate from day to-day, heaps of old iron, broken tools, waste and sweepings piled in a corner, small tools lying indiscriminately about the benches, floors and window-sills with a kind of indication that the dust of ages has been allowed to settle upon everything not regularly called into use, yet shops presenting such an appearance are are to be found every day. A large machine shop could hardly be managed without some approach to system, yet many of them are sadly deficient in the observance of "Heaven's first law." How it is possible to turn out good work in these ill-conducted shops is a wonder to us, but inasmuch as the thing is done they hold a measure of public patronage. The *best* work, however, can not be obtained in shops that present a slovenly and careless appearance; the more slovenly they are the poorer is likely to be the character of the work.

There are many degrees of order and neatness to be found in different machine works from one extreme to the other. We know of shops where a workman who left a hand tool on the bench lengthwise would be in danger of a discharge, and others where he could toss it under the bench with perfect impunity. It is a favorite excuse of many superintendents of small shops that they do not need to observe a system—that it is only necessary in large shops. This is a great mistake, for it is careful attention to system that enables shops to make progress and enlarge.

It requires no great effort to keep up a good method of management when once inaugurated. Go into the workshop where order and neatness are the rule, not the exception, and observe how cheerfully the men employ themselves, giving evidence that their chief interest lies in their present occupation, and that their ambition is to excel. You will notice no apparent restraint, no undue haste to execute the job in hand. It would not take long to become impressed with the idea that first-class work is assured in this establishment. Each man feels that his reputation as a mechanic, as well as that of his employer is at stake, and he does his "level best." Next enter the shop where business is done at hap-hazard, and note the difference. The workmen wear an aspect of uneasiness and irksome confinement; they ply their tasks as though anxious only to fill in the time. When the whistle blows they drop their work with an alacrity unsurpassed. The best machinists would scarcely be found in such a shop. The model machine shop is conducted on the most approved system, and is always noted for the excellence and progressiveness of its manufactures.

The Eagle Boiler Tube Fraud.

We repeatedly hear of instances where parties have been solicited to buy second-hand re-drawn Eagle tubes upon the understanding that they were new tubes; but the fraud has become so well known that scarcely any boiler maker in this country, however small a business he may have, has not heard more or less about it, and with ordinary care need not be deceived thereby. The old Eagle tubes are offered very low, which may account for their use by several well-known boiler makers in this vicinity and elsewhere, who know full well the flimsy and unreliable character of the tubes, and whom we venture to assert, would very much object to have it publicly known that they are using them. No matter how large or long established a concern may be, the employment of poor and weak material in making steam boilers, with a correct knowledge of its character, should place a foul blot upon its reputation. Every few days we read in the daily papers about boiler explosions and loss of human lives; the blame in most cases being traced to defects in the boiler itself. One of the most extensive New England boiler makers informed us a few days since that the agent of the Eagle Tube Co., of this city, had solicited him to buy their tubes at a low price, representing that they (the Eagle Tube Co.) *manufactured* boiler tubes. The answer was that he (the boiler maker) would call at their works and see the process of manufacture; whereupon the agent informed him that no outside party was allowed to enter the works. The boiler maker then pronounced the Eagle Tube Company a fraud because of palming off old re-drawn tubes for new ones, and the agent departed with a flea in his ear. We mention this only as an example of the method employed to dispose of Eagle tubes to parties who are supposed not to be acquainted with them.

In some instances that have come to our notice, it would appear that certain dealers had been selling re-drawn tubes, purporting to be made by well-known reliable tube manufacturers. Of this we shall have more to say hereafter when we have thoroughly investigated the cases. No *manufacturer* of boiler tubes makes it a rule to exclude all visitors from his works, for the process of manufacture is not a secret one. Every long-established manufacturer of boiler tubes stamps with a die every tube with his trade-mark; also, has it stenciled thereupon with paint. Eagle second-hand re-drawn tubes are not marked with any stamp; they are, moreover, irregular in weight and in shape, not being round or of uniform thickness. Careful inspection will show their flimsy character before using; but after placing in a boiler their defects are covered up. Steam users should give more attention to the tubes when purchasing a boiler, as they are likely to give way before any other part of the boiler.

Workingmen's Lyceum.

We feel gratified to report that the appeal to the workingmen of New York City urging the formation of a Workingmen's Lyceum, which we endorsed in our last number, has met with cordial approval and marked success. We learn that the Lyceum has been forming for some time, that it numbers at present about 150 members, and that a library and reading rooms have been opened in the Bond Street Savings Bank Building, corner Bond Street and Bowery. The Library is open Monday, Wednesday and Saturday evenings from 8 to 10 P. M., and Sundays from 2 to 6 P. M. It contains about one thousand volumes on miscellaneous subjects, on history, geography, and travels, standard literature and works of fiction, pure and applied sciences, but it is principally devoted to matters relating to social and moral philosophy, political economy, and to statistics showing the conditions of labor in general.

We print below the preamble of the Constitution, which we cheerfully and earnestly recommend to the notice of our readers:

PREAMBLE.

Whereas, the need of more effective measures to secure the elevation of the Working Classes has become apparent, and

Whereas, we whose names are hereunto subscribed do now propose to enter into an organization for the aforesaid purpose.

Resolved, that the following be enunciated as the principles that shall guide us in our joint efforts:

That union alone can lead to success; that a general union of Workingmen on the basis of politics or trade interests seems to us under present conditions imposible.

That higher and more general education is the sole means of securing a gradual triumph in our struggle for larger justice.

That the elevation of the working people concerns not only themselves but will redound to the lasting benefit of the whole community, that it is *the cause not of one class against other classes, but the common cause of all classes*, the noblest interest of a common humanity.

Now, therefore, in accordance with these views we do now combine in an organization to be known as "The Workingmen's Lyceum of the City of New York."

The object of the Lyceum shall be in general the elevation of the working people by education.

The specific means to be employed to this end shall be: a system of lectures to be delivered by competent persons chiefly on the subject of the great laws that govern the movements of industry and affect the social well-being, a free circulating library, reading rooms and such other appurtenances as serve the same end. The ultimate object of the Workingmen's Lyceum shall be the erection of a Mechanic's Institute in the City of New York to be under the control of the Workingmen themselves, to be the visible token of their union, to be a centre from which beneficent influences may radiate in every direction, to be a substantial means of giving dignity to the Workingmen's cause both in their own eyes and in those of the surrounding community.

Pettengill's Newspaper Directory and Advertisers' Hand-Book for 1878 has just been received from the publishers, S. M. Pettengill & Co., of this city. It is the most complete, well-arranged and valuable work of the kind we have ever examined. Judging from what we know of the publishers, as well as from a perusal of the book itself, we depend upon it as *reliable*.

We shall mail copies of the June issue of the AMERICAN MACHINIST to those interested in machinery in each of the following countries: All countries of Europe, South America, Central America and British American provinces, Mexico, Australia, West India Islands, India, South Africa and Egypt; also to a select list of about 400 parties in New York, Philadelphia and Boston who are making a specialty of exporting merchandise.

MANUFACTURES.

NEW YORK.

The Abendroth & Root Manufac'g Co., New York, are running their works night and day on orders, and are employing 100 men.

Brooks' Locomotive Works, at Dunkirk, N. Y., were about to close, when they received an order for five locomotives, and a probability of more to follow.

The Niagara Bridge Works, at Buffalo, N. Y., have recently completed and are now building several small bridges, including two for the Grand Trunk. They are also building an iron trestle and coal dump for the Boston & Albany, at Boston, which is to be 300 feet long, with a platform at the upper end 60 feet wide.

MASSACHUSETTS.

Baxter D. Whitney, Winchendon, Mass., has just sent three wood-working machines to England, and has other orders from that country.

The shovel works of Oliver Ames & Son, at North Easton, Mass., are now quite busy, and are running twelve hours per day in some departments.

The Lamb Knitting-machine Co., Chicopee, Mass., have contracted to furnish a Boston house with three tons of small castings per week for the next eighteen months.

CONNECTICUT.

Reynolds & Co., New Haven, machine screw manufacturers, are employing seventy-five hands, running on full time, and have plenty of orders.

Sawtelle & Judd, Hartford, are employing fourteen men, and doing a fair business. The demand for their Independent Air Pump and Condenser is growing, and finds favor wherever introduced.

John Adt, New Haven, is about bringing out several new automatic straightening wire cutting machines, combining some valuable improvements. These machines will straighten wire of all sizes to any length, and also another improved machine for cutting and forming wire. Mr. Adt reports business good, is running full time and employs eighteen hands.

The Taylor Manufacturing Company, New Britain, Conn., are now shipping five tons of toy pistols per week to Germany and England, and are compelled to build an addition to their iron foundry to keep up with the demand. They employ forty men in this branch of manufacture alone. The Taylor Company are also making fine iron castings for several Boston manufacturers.

PENNSYLVANIA.

The Reading Iron Works employ between 700 and 800 hands in their rolling mill, tube works, nail factory, furnaces, machine shop, foundry, and forge.

During the past two weeks the Baldwin Locomotive Works, Philadelphia, have received orders for some fifteen locomotives. The company has just disposed of four engines to the Atchison, Topeka and Santa Fe railway.

At the Black Diamond File Works, Philadelphia, G. & H. Barnett, proprietors, business is said to be unusually active. They have been working for some time past with a full force of hands, but are unable to keep pace with their orders, some being from distant points—Mexico, Brazil and European countries.

The old Mechanical Works, at Johnstown, have been taken charge of and are now being operated by a new company, organized under the name of "D. G. Gautier & Co., Limited," with a capital of $300,000. The new firm is composed of the steel manufacturing firm of D. G. Gautier & Co., of New Jersey; Henry Roberts, wire manufacturer, of Newark, N. J., and the Cambria Iron Works. We recently saw a beautiful engine at the Corliss Steam Engine Co.'s Works, just built to supply power to this new establishment.

OHIO.

Business is good at the Novelty Iron Works, Cleveland, fifty-six men working full time on machinery and bridge work.

The Lima Machine Co., Lima, Ohio, are running full time, employing 50 men and have prospects for a good season's business.

The steel mill of the Burgess Iron & Steel Co., at Portsmouth, O., which was recently burned down, has been replaced with a new building and is now actively at work.

Hennessy's boiler works, Youngstown, resumed operations the other day, after being shut down two years. The proprietor says his prospects are fair for plenty of work for some time to come.

The King Bridge and Manufacturing Co., Cleveland, are running on full time, and employ 150 men. They have lately contracted for 550 feet of bridges in the State of Maine, and have taken sixty-two bridges since the first of January.

Bourne & Knowles, Cleveland, manufacturers of hot and cold pressed nuts, washers, rivets, etc., started up on ten hours the other day. They had been previously running nine hours only. They are now behind their orders, which are coming in rapidly, and they anticipate brisk business for some time.

We learn from the Cleveland *Trade Review* that a successful trial of the Brush electric light was made at the Union Steel Screw works on a recent evening. The machine used was of 12,000 candle power light, four currents, with two burners on the third floor, and two on the fourth floor. It was stated that the cost of the light produced by this machine did not exceed thirty cents per hour, while gas light of one-third the same brilliancy would cost about three dollars an hour.

NEW JERSEY.

The Grant Locomotive Works, at Paterson, N. J., is rapidly completing the locomotives ordered by the Gilbert Elevated road.

The Victor Pipe Wrenches are spoken very highly of by those who use them; we understand that the manufacturers have already received large orders from the principal pipe and supply houses throughout the country, and are behind their orders. Lathrop & Co., 200 Market street, Newark, N. J., are the manufacturers.

WEST VIRGINIA.

L. Spence's Ohio Valley Agricultural and Steam Engine Works, Martin's Ferry, are running on full time with a full force of men. The trade for machines is quite brisk, and the prospects for the season very flattering. The works are now putting up two stationary engines for flouring mills at Ryerson's station, Greene county, Pa., and have some orders for portable threshing engines.

Exports.

Lathrop & Co., Newark, N. J., have just shipped, on order, a lot of their Victor pipe wrenches to England and Australia.

Metcalfe, Paul & Co., of the Verona Tool Works, Pittsburgh, are supplying a large number of their Verona nut-locks to the Dom Pedro Segundo Railroad in Brazil.

H. Prentiss & Co., New York, have recently made shipments of their goods on orders, to the Sandwich Islands and Germany. This firm have established a good export trade.

The American Dredging Company have built a dredge for the Government of Nicaragua, which is to be shipped in parts for erection at Greytown. It is a dipper dredge, with bucket of one cubic yard capacity.

Pitkin Bros. & Co., boiler manufacturers, Hartford, are about to ship two boilers to Cuba. They have quite a trade in the West Indies and South America, as they also manufacture sugar tubs, tanks, pans, and cane cars. They employ one hundred men, and are doing a good business.

Advertising Humbugs.

[From the *British Trade Journal*, May, 1878.]

The AMERICAN MACHINIST sets a good example to journalism by its refusal to admit to its columns upon any terms whatever that class of advertisements intended to mislead by extraordinary pretensions, and induce the unsuspecting to part with their money and time without receiving a fair equivalent.

It says the astonishing offers of "$10 a day to agents;" "$66.47½ a week, sure;" "$100 a month and all expenses paid—permanent employment;" "gold watches for $3 with a sample watch free to agents;" "magnificent caskets of jewelry for $1, sent free by mail on receipt of price;" "a $12 watch for $3;" "money easily made, only $1 capital required to start you;" "a fortune for all—enclose stamp for particulars," and many others of this sort are given publicity for the purpose of duping the readers of papers in which they appear and fattening upon their credulity. The preparation of these advertisements must be an art, and a very cunning one too, for the greater the deception the greater the profit. A foreigner just arriving in our country might be led to believe, by looking over the columns of papers that sell space to advertise these wonderful schemes for making money, that any one with energy and ambition could easily acquire a fortune with but little labor. Every newspaper publisher has sufficient knowledge of the character and objects of such advertisements not to be deceived by them; but thousands of gullible youths, and many men of mature age, are taken in because they find them in papers in which they have become accustomed to place confidence.

The AMERICAN MACHINIST, monthly, shows more vitality than any other new enterprise of its character, in the country.—*St. Louis Review.*

The AMERICAN MACHINIST is the title of a new scientific monthly, which gives evidence of being edited by thoroughly practical men. Its typographical appearance is also unexceptional.—*American Art Journal.*

The increased railway earnings this year, says the *North American*, seem to indicate a grand revival of business, or at least that the stagnation is giving way. The produce of the interior seeking transit is in much larger quantities, and the rates are more remunerative. It is probable that had not Congress undertaken to reconstruct the currency and tariff there would have been a general revival of trade all over the country.

Questions and Answers,

Under this head we propose to answer questions sent us pertaining to our specialty correctly and according to common sense methods.

(1.) L. B., Zanesville, Ohio, asks: 1. Why does a barrel of flour weigh 196 lbs? Why not make a standard barrel of flour 200 lbs. or some even weight? A. It arose from an old English weight the table of which is as follows: 14 lbs. make one Stone; 2 Stone (28 lbs.) one Quarter; 7 Quarters or 14 Stone one Barrel of Flour. This 196 lbs. barrel of flour has been the standard so long, that like other weights and measures in long use, it is very hard to change. 2. Would it be more practicable to make a steam boiler all out of solid iron by welding all joints instead of riveting? How much more pressure could you carry in proportion to boilers riveted? A. It is not practicable to weld the joints of a boiler so as to make it reliable to carry steam. Welding at best is an imperfect way of uniting two pieces of metal, and the thinner the two pieces the less dependence is to be placed upon the weld. Welding has been tried with the compound blow-pipe, and about fifteen years ago excited considerable discussion in English scientific papers, but it proved a complete failure.

(2.) J. L., Zanesville, Ohio, writes: Please answer through your valuable paper the difference in strength of a boiler in solid iron, or the seam or lap where boiler sheets are riveted together, 2 inch lap, ⅝ inch rivets, 2¼ inches apart. Which is strongest, and why, and how much difference in strength? A. The solid part of the boiler is the strongest, because a portion of the plate has to be cut away to admit the rivets. The effective area of the plate is reduced by a sum equal to the area of the rivet-holes; besides, the plate between the holes is in some degree injured by punching. The joints give way by the shearing of the rivet, crushing of the plate, or tearing out of the rivet. Nearly every boiler-maker has a different way of estimating the differencc in strength. In ordinary practice, the difference in the example given above, is about 60 per cent. if a flat punch is used. If drilled or punched with the spiral punch it may be reduced to 50 per cent. Very little is gained by the friction of the rivet.

(3) J. C. G., Marlboro, Mass., says: I see by your last number that you are to begin your next number by questions and answers to correspondents. The plan is a good one, and I like it much Shall commence by sending you one. I say that it does not make any difference how large a suction-pipe is to a pump. Tinsmith says it does make this difference: If the pipe is larger than the pump calls for, the pump will work harder. I do not see why a common house pump will not work as easy on a twelve inch pipe as on one two inches or one inch, the pump to be same height from the water. A. The labor of pumping is in exhausting the air from the section pipe. The pump is a lever, and, as you will see, its operation is governed by the law of the simple lever. If the suction pipe is too large or too small for the pump (lever) it will of course work harder. Pump manufacturers generally make the suction pipe half the diameter of the bore of the pump.

(4.) W. S. H., Croton Falls, N. Y., writes: I saw in your last issue an invitation for questions to be asked, and I have one. I am making a micrometer caliper, and wish to cut a screw for it that will move just one millimetre at each turn; the lathe I have to cut the screw on is an engine lathe geared to cut from 4 to 80 to the inch, and the lead screw is ten to the inch. The lathe is one of N. H. Baldwin's No. 3 Screw Cutting Lathes. A. A millimetre is equal to .039370 + of an inch. If your leading screw is perfect 10 pitch, use a gear with 50 teeth on the spindle, and one with 127 teeth on the leading screw. This cuts a screw that will move .0393700 + of an inch in length at, which you will see is correct to six decimal places. The fraction left is immeasurable. See "Gearing a Lathe for Screw Cutting" on page 3.

A correspondent inquires as follows: "I have seen extensively advertised in mechanical journals a work entitled 'Allen's Artificers' Assistant,' which purports to be a very valuable work and cheap in price. I notice it endorsed by a number of journals. Will you please inform a subscriber whether this work is all it is represented to be?" The work in question is a good one, and was fully endorsed by us in our issue of February last, which see.

TO REVERSE AN ENGINE.—Make a legible mark on the eccentric near the shaft, make a similar mark on the shaft at the same place. Now place one point of the callipers on the mark made on the shaft, and with the other point ascertain the centre of the shaft on the opposite side, making another mark there also. Next unscrew the eccentric and move it in the direction in which you wish the engine to run, until the mark on the eccentric comes into line with the second mark on the shaft, then screw the eccentric fast and the engine will run the reverse way.

The Growth and Present Position of the Science of Machines.

BY PROFESSOR A. B. W. KENNEDY, C. E.

Concluded,

And now, lastly, as to the progress of machine design, so far as it has been reduced to a science, and connected with the molecular resistance of materials, it was Redtenbacher who first fairly separated this study from mechanics, and systematized and extended it. Indeed it may be said that it was he who created machine design as a separate branch of science. His "Resultati für den Maschineubau" was published in 1848, and although much progress in details has been made since then, and his method of treatment may in many cases be greatly simplified, and must in some cases be entirely altered, this work and his public lectures ("Die Maschineubau") remain classics. The direction of progress since his time has been in the more and more complete reduction to a scientific basis, of the numerous determinations formerly made upon grounds of "experience" alone, that is empirically; and no year passes without some such gains to science at the expense of empiricism.

Duriug the last thirty years a host of experimenters have been at work investigating the strength of iron and steel. As time has gone on the experiments have been made more and more complete and accurate, and in some particular branches of the subject the experiments may be said to be complete, so far as concerns the constructive materials now most used. We have, for instance, thanks in great measure to Mr. Kirkcaldy, little left to learn as to the ultimate tenacity of many qualities of iron and steel, and as to their behavior when near the breaking point. But, unfortunately, many new fields for experiment are opening up. Engineers are not in the habit—intentionally, at least—of straining the members of their structures or machines to near the breaking point; and as the behavior of many materials, when exposed only to small stresses, differs greatly from their behavior under larger ones, it is now recognized that our knowledge of the strength of a material is incomplete unless we know to what extent it is affected by such small loads as it usually receives in practice. New experiments, so far as they are to have scientific value, must now take this direction, and new apparatus is required for them, much more delicate in its operation than the former machines.

Modern experiments on the strength of materials have given us two conclusions, which have a specially important influence on machine design, and which I must not pass over without mention. The first of these is that the fracture of a material does not depend solely on the magnitude of the load resting on it, but also on the number of times which that load is applied. A bar of iron will be ulimately broken by many repetitions of a load of only about sixty per cent. the load which will cause immediate fracture;

and, as in most machines as well as structures the loads which do occur are repeated over and over again, it follows that the ultimate resistance of the parts of the machine to fracture is not much more than half what is indicated by the ordinary testing machine. The fact was established experimentally long ago by Fairbairn and others, and more lately very completely by the experiments of Wöhler on the "Fatigue of Metals," which extended over some twelve years, and were conducted with specially constructed machines. In many cases one single piece of material was subjected to many million (in one case once 130 million) repetitions of load. The second conclusion, also established by Wöhler, is of even greater importance. It is, that the resistance of material is not, *cæteris paribus*, dependent on the maximum load to which it is exposed, but to the difference between the maximum and minimum loads, that is, to the range of stress. This discovery has now been fully substantiated in principle, and there can be no doubt that the design of machinery as well as structures, so far as it depends on the strength of the material used, should be based on this law, carried out by help of formulæ derived from it. Such formulæ have already been investigated, and some of them (notably that of Launhardt and Weyrauch's addition to it) appear to represent very well the physical conditions of the case, so far as they have yet been determined. The Bavarian Government have already gone so far as to adopt what they should call "Board of Trade Regulations," upon formulæ of this kind. The experiments already made have not been, however, numerous enough to determine the constants required for these formulæ, and very much still remains to be done in this direction.

I am no prophet, and will only say one word as to the future of machine science. Judging from the direction taken by it hitherto, we may infer that as more and more work is done in it we shall be able to get more and more distinctly at the ideal of every machine we design, and to see more clearly the highest form of the object at which we are aiming. At the same time we shall understand more and more completely the physical and other conditions which prevent the actual attainment of our object in this form. The more accurately we know these conditions the more closely shall we be able to bring our machines to the best form attainable under them. More than this: as we get to know these conditions more and more accurately, we shall see to what extent they are essential, and how far we can remove them. In the one case we can admit them as modifying our ideal machine, in the other case we get over them with our practical machine. In both processes our practical work and our ideal are brought closer together. Already with some special machines, the real and the ideal have almost met. I look forward to the time—although we shall not see it—when the same condition shall have been reached in the complex machines of every-day life, and when the growth of machine science shall have made it possible to produce a steam-engine as perfect in its whole working as, say, the motions of Sir William Thomson's tide-calculating machine. "After this, the deluge."

Machinists' and Engineers' Supplies.

There is a very dull market for nearly everything in the machinists' supply line the past month, showing but little activity. Prices are slow to change, partly because there is not enough business to warrant an advance, and partly owing to a conviction that reducing prices would not stimulate the demand.

Hoopes & Townsend, of Philadelphia, have issued a neat illustrated catalogue of bolts, nuts, washers, rivets and like goods, for bridge builders, railroads, &c They state that they have improved their manufactures in many respects, and advanced their facilities for rapid production.

N. Seibert, Boston, has issued a reduced price list of his Eureka Lubricating Oil Caps, for all kinds of engine cylinders. The half pint cut is reduced from $25 to $23; the pint cut from $45 to $35; the quart cup from $55 to $40, and the half gallon from $70 to $50. Pump cups remain at $12 each. The cost of nickel plating is from $3 to $5 extra.

The Advance Oil Works, of Brooklyn, have established an office and salesroom at 16 Courtlandt Street. Their Cylinder Oil is becoming quite popular.

The export trade in machinists' small tools is every month becoming more important, especially to Europe and Australia.

Antoxide is the name of a new liquid compound, made by the National Antoxide Co., 87 Liberty Street, New York. It effectually prevents rust on iron or steel, without injuring the metal. It is being used with great success on machinery.

The Pratt & Whitney Co. have issued a fine illustrated catalogue, 90 pages, quarto, of their machinery. It shows some new and improved tools.

Frasse & Co., 62 Chatham Street, have improved their Adjustable Round Die Holder, by reducing the size of the handle, and blueing the centre. This makes it lighter, better proportioned, and handier to use. They are now placing their sets of screw cutting tools in velvet-lined morocco boxes. Their new adjustable tap wrench is having a large sale.

Iron Review.

No marked improvement is noticeable in the market, and only a moderately active business done. It has been rumored that parcels of standard brands had recently been offered below $18 for No. 1, X; but if sales were made, which we fail to learn of, they were under exceptional circumstances. There is no change to note in standard brands, and we quote No. 1, Foundry, $18 to $18.50; No. 2, $17 to $17.50, and Gray Forge, $16 to $16.50. Scotch Pig is selling rather more freely, but only in small parcels. Eglinton, $22.50 to $23; Glengarnock, $23 50 to $24. and Coltness, $25 to $25.50.

MANUFACTURED IRON.—The trade is very quiet, but the base price of 2c. a pound for good refined bar is insisted upon. Business seems to be dull at the mills, and on large orders concessions can be obtained.

RAILS.—There has been no business done worthy of note, and prices remain unchanged at $43 to $44 at mills. In Iron Rails there has been but few sales, prices remaining at $33 to $34 at mill.

WROUGHT SCRAP.—But little inquiry, and the quotations are $20 to $21, from yard. One lot of 300 tons sold at $20.

STEEL.—There is a fair inquiry, but not much doing except in small orders for sorting up. Prices remain unchanged.

TANK, PEATE AND SHEET IRON.—A fair business doing, and some considerable inquiry that warrants a belief that more activity may be expected. Store prices remain unchanged, but firm. Tank Iron @ 2¾ to 3; C, No. 1 Iron @ 3; C. H. No. 1 Shell @ 3½; Best Flange @ 4¼ to 5; Soft Patch Iron @ 6½; Boiler Rivets @ 4 to 4¼; Sheet Iron, No. 10 to 18 @ 3; Boiler Tubes list price less 20% discount.

This Work is very Reliable, and is strongly Recommended by the Leading Scientific, Mechanical and other papers, as will be seen by the Testimonials below.

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"This is undoubtedly the cheapest work of the kind ever published. "It contains 700 pages of closely-arranged matter. The author and "compiler has covered very extensive ground, and the recipes and in- "structions are carried down to the latest date."—*Scientific American.*

"It is a plain, practical work for every-day use in the shop, and "will be found valuable alike to apprentices and skilled workmen. "It avoids algebraic formulas and mathematical problems, while giv- "ing in available form such information as machinists, engineers, and "other artisans should acquire. The price is low enough to bring "it within the reach of everybody."—*American Machinist.*

"It is one of the most valuable books for the money we have seen. "In the household, factory, mill, or shop, it will be of the greatest "service. Its vast amount of useful matter is made available by a "complete and comprehensive index, by which anything in the book "can be easily found. It is a book which, once possessed, would not "be willingly parted with."—*Leffel's Illustrated Mechanical News.*

"This work is very reliable, and is strongly recommended by this "paper."—*Scientific News.*

"The possessor of a library will find herein many matters of infor- "mation for which he will search in vain elsewhere."—*Manufacturer and Builder.*

"This is no catchpenny publication. It is a book that every reader "should possess. It is beautifully printed and bound; contains over "700 pages, largely illustrated. For $2.50 you can get this valuable "work, and will thank us for putting you on the track of it."—*Louisville Courier-Journal* (in answers to correspondents.)

"It is a very valuable work; every family should have a copy; the "money paid for it will not be wasted."—*The Household.*

"This is the cheapest book for the price ever published. We recom- "mend it strongly to the notice of all book agents on the lookout for "good and salable works."—*Agents' Herald.*

Among the multitude of subjects of which it treats, will be found the following: Telegraphy, of which it is a perfect self-instructor, teaching the construction, manipulation and management of Instruments, Batteries, Wires, &c., Reading by sound, The Learner's Instrument, How to learn telegraphy at home in a short time. One Hundred and Fifty valuable Mechanical Movements, Illustrated and Explained. Information concerning Patents; how to obtain them. Tuning the Pianoforte, Organ, Melodeon, a complete self-instructor, Watchmaking, the whole process of manufacture in detail. Watchmakers' Train Tables. Directions for the construction and management of Engines, Boilers, Gauges, Valves, &c. Duties of Engineers. Cements for Steam work, Composition Boiler Covering, Steam packing, Scale preventatives, Polish for bright work; Useful hints for Millers and Millwrights; Saw Mills and Shingle Machines, Rules for speed of Wheels, Pulleys, Drums, Circular Saws, &c.; Saw filing, full directions; Mending Broken Saws, Shafting, Belting; Gear Cutting, Bevel Gears, Friction Paper Pulleys, Screw work, Planing, Boring, Turning, Finishing, &c.; Making and Tempering Railway and Carriage Springs, Saws, Axles, Steel Ploughs, Files, Taps, Reamers, Cold Chisels, Marble and Stone Cutters' Tools, Stone Drills, Dies, Mill Picks, Edge Tools, Scissors, Razors, Scythes, Gun Lock Springs, Watch Springs; Emery Wheels, different kinds; Tempering Liquids, 7 kinds; Metallic Tempering Bath; Case Hardening, 6 ways; to Restore Burnt Steel, 4 ways; Annealing Steel, &c. To toughen and improve poo. Steel and Iron; to Reduce Oxides; Alloys for Gold, Silver, Brass, Bronze, German Silver, &c., 250 kinds; Solders, 75 kinds; 100 Compositions for Locomotive, Organ Pipes, Pumps, Telescopes, Plated Goods, Gongs, Cymbals, Metals, &c., &c.; 26 receipts for Tinning, Blueing, Galvanizing, Coppering, Brassing, Zincing, and Enameling on metals; 77 receipts for Bronzes, Dipping Acids, Lacquers, Paints, Japans, &c., for metal work, Bronze Powder, 9 kinds. 94 receipts for Coloring, Gilding and Plating; 375 very valuable receipts for Watch, Chronometer, Clock and Jewelry work. Over 1,000 reliable processes for Iron, Steel, Saw, Tube, Chain, Anvil, Sewing Machine, Gas fixture, and Fire-arm Manufacturers, Master Mechanics, Machinists, Engineers, Blacksmiths, Horseshoers, Carriage Makers, Iron, Brass, Type and Bell Founders, Pattern Makers, Refiners, Gunsmiths, Cullers, Millwrights, Coppersmiths, Gas and Steam Fitters, Plumbers, Marble workers, Opticians, Die sinkers, Stencil cutters, &c. Glass, Glass Staining, Etching, and China Decoration, 50 receipts. To Gild Glass Signs, 8 ways; Stains for Wood, Polishes, Wood filling, Oil Finishes, 100 kinds. 300 receipts for House, Sign, Ship, Carriage and Ornamental Painters, Grainers, Cabinent and Musical Instrument Makers, Gilders, Carvers, Polishers, Picture Frame Dealers, Varnishers, Stucco Workers, &c.; 40 receipts for Cement and Glue. 60 receipts for Tanners, Boot, Shoe and Harness Makers. 150 receipts for Dyers, Bleachers, Hatters, Clothiers, &c. For Dentists, 25 receipts; Moulders', Pattern and Model Makers' Tables, Weights of Iron, Steel, Brass, Copper, Lead, Russia Iron, Lead Pipe, Strength of Cast Iron Columns, &c., at sight. Estimates of Supplies for Lumber Camps. Estimates for Masons, Plasterers and Contractors. Diagrams for Machinists. Full instructions for making Artificial Flowers, Fruit, &c., for taxing Ferrotype, Tintype, and other positive pictures; for Making, Bottling and preserving all kinds of Ales, Wines, Spirits, &c., 150 receipts. For manufacturing Confectionery of all kinds, 150 receipts. The whole Art of Brewing; Cage Birds and their Diseases, Taxidermy; Rules for the Games of Billiards, Pool, &c,. Book-keeping, by both double and single entry, condensed and comprehensive; valuable information for Farmers, in regard to Horses, Cattle, Poultry, Composts, &c. More than 1100 receipts for Cooking, Baking, Preserving, Pickling, &c. There is so much that is valuable in this work that we can give only a faint idea of its contents.

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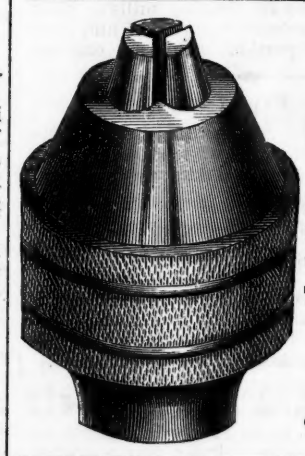

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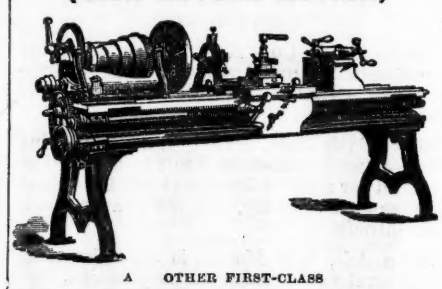

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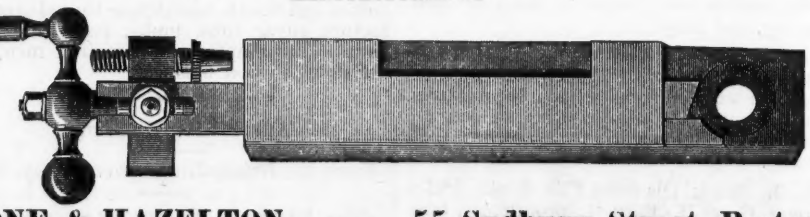

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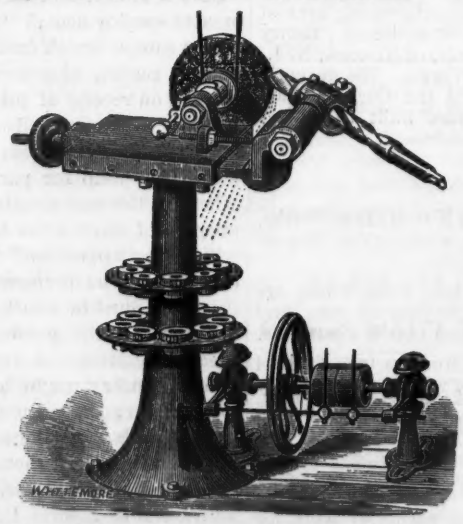

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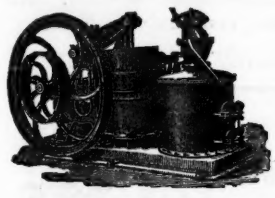

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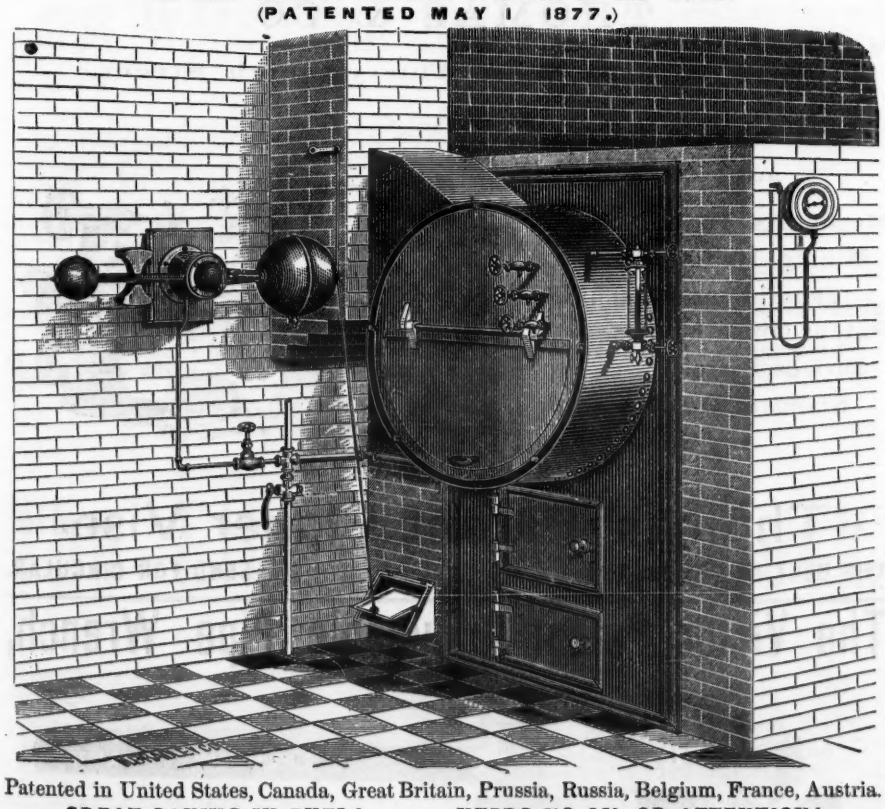

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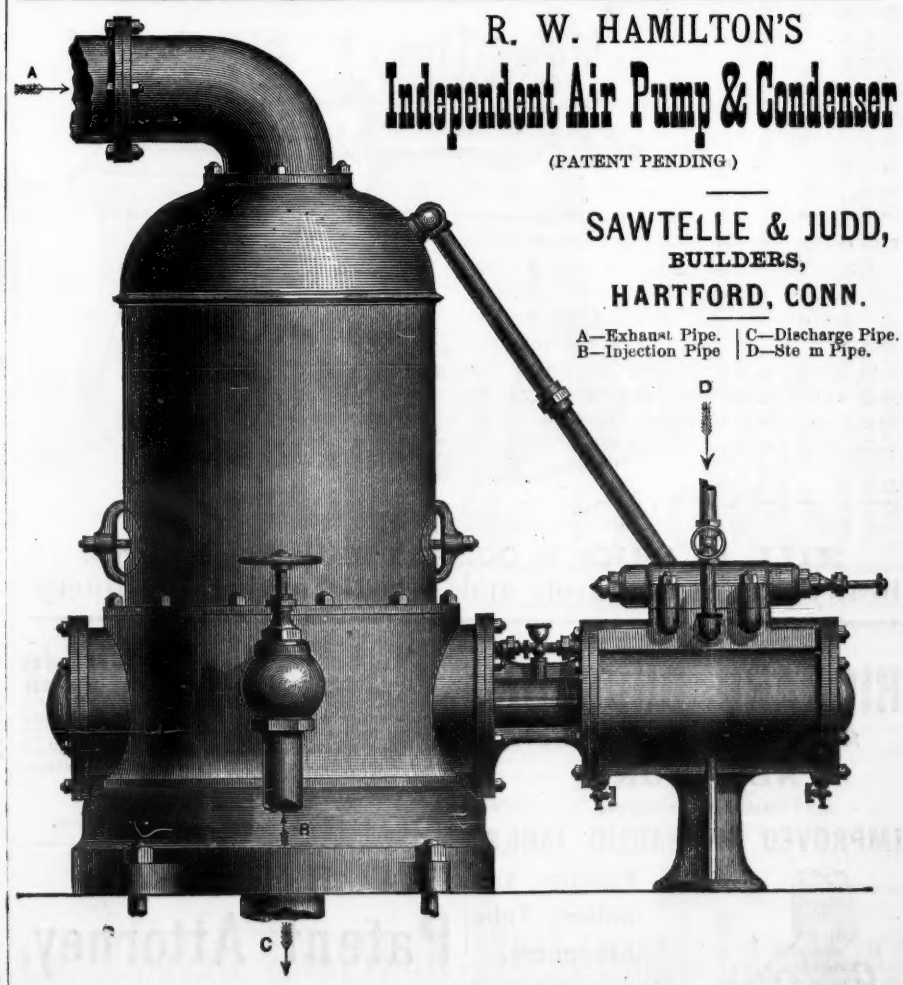

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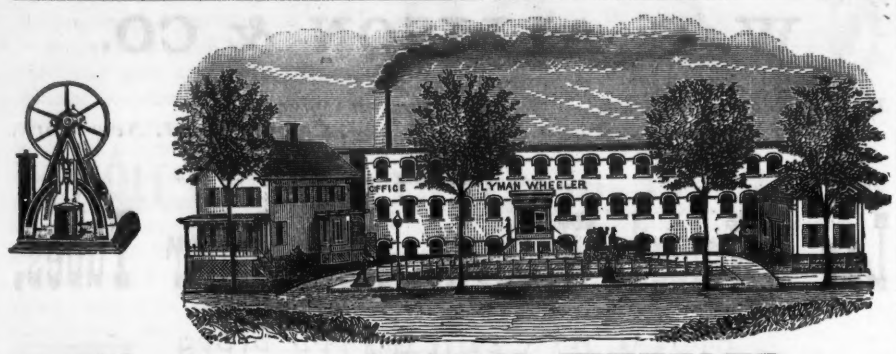

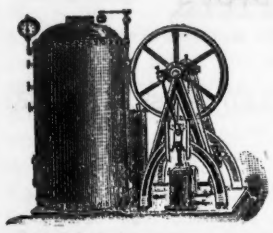

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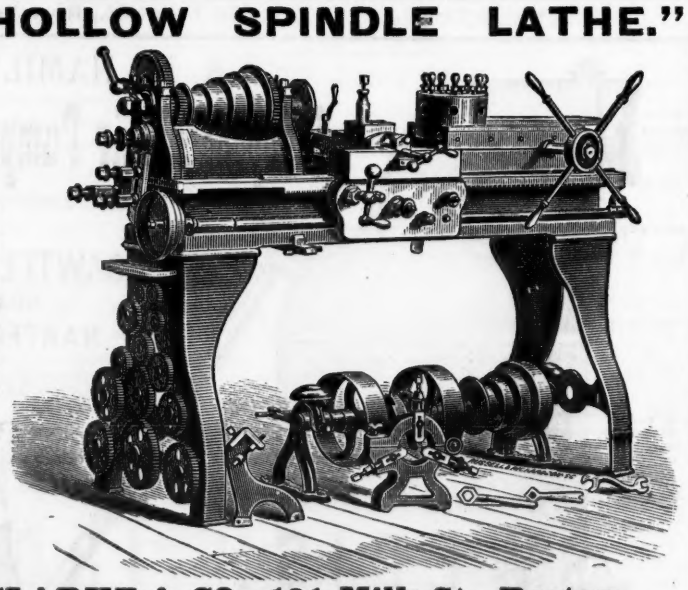

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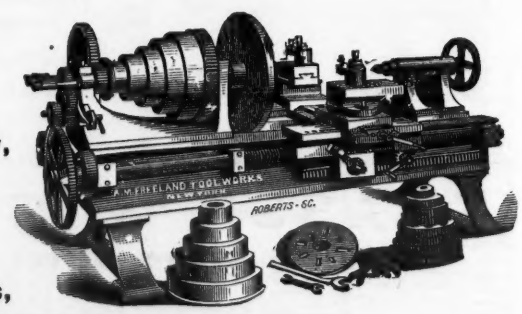

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⅝×16	14	12	10	$\frac{3}{16}$	¼ & $\frac{5}{16}$
$3\frac{4}{10}$	$3\frac{2}{10}$	3	3	$2\frac{9}{10}$	$2\frac{7}{10}$
¾×16	14	12	10	$\frac{3}{16}$	¼ & $\frac{5}{16}$
$3\frac{2}{10}$	$3\frac{1}{10}$	3	$2\frac{8}{10}$	$2\frac{7}{10}$	$2\frac{6}{10}$
⅞×16	14	12	10	$\frac{3}{16}$	¼ & $\frac{5}{16}$

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⅜	$\frac{8}{10}$	$2\frac{1}{2}$ to 3	$\frac{4}{10}$
$\frac{7}{16}$	$\frac{6}{10}$	$3\frac{1}{2}$ to $3\frac{1}{2}$	$\frac{6}{10}$
½ and $\frac{9}{16}$	$\frac{4}{10}$	$3\frac{3}{4}$ to 4	$\frac{8}{10}$

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$1\frac{8}{10}$	$1\frac{1}{10}$	$\frac{8}{10}$
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$1\frac{1}{10}$	$\frac{8}{10}$	$\frac{4}{10}$
⅝×⅓ and $\frac{3}{16}$	¼ and $\frac{5}{16}$	⅜ to ⅝
$\frac{8}{10}$	$\frac{6}{10}$	$\frac{4}{10}$
⅞×⅓ and $\frac{3}{16}$	¼ and $\frac{5}{16}$	⅜ to ¾
$\frac{4}{10}$	$\frac{3}{10}$	$\frac{2}{10}$
1×⅓ and $\frac{3}{16}$	¼ and $\frac{5}{16}$	⅜ to ⅞

$\frac{4}{10}$	$\frac{8}{10}$	$\frac{2}{10}$
$1\frac{1}{8}$×⅓ and $\frac{3}{16}$	¼ and $\frac{5}{16}$	⅜ to 1
$1\frac{1}{4}$ to $4\frac{1}{2}$×¼ and $\frac{5}{16}$, / " ×$1\frac{1}{8}$ to 2	•	$\frac{3}{10}$
$4\frac{3}{4}$ to 6×⅜ to 1 / $4\frac{3}{4}$ to 6×¼ and $\frac{5}{16}$ / " ×$1\frac{1}{8}$ to 2 / $6\frac{1}{4}$ to 7×⅜ to 1 / $2\frac{1}{4}$ to 3×$2\frac{1}{8}$ to $2\frac{3}{4}$ / $6\frac{1}{4}$ to 7× ¼ and $\frac{5}{16}$ / " ×$1\frac{1}{8}$ to 2 / $3\frac{1}{4}$ to 4×$2\frac{1}{8}$ to 3	- - -	$\frac{4}{10}$
	- - -	$\frac{6}{10}$

Ovals.

$\frac{8}{10}$	$\frac{6}{10}$	$\frac{4}{10}$	$\frac{2}{10}$
½ and $\frac{9}{16}$	⅜ and $\frac{11}{16}$	¼	⅛ & up.

Half Ovals and Half Rounds.

$1\frac{3}{10}$	$1\frac{1}{10}$	$\frac{8}{10}$	$\frac{4}{10}$
½ and $\frac{9}{16}$	⅜ and $\frac{11}{16}$	¼	⅛ & up.

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" 3-16 up,	5c
" " " " 5-32 up,	$5\frac{1}{4}$
" " " " 1-8 "	$5\frac{1}{2}$
" " " " 3-32 "	$5\frac{3}{4}$
" Spring Steel,	5
" Tool Steel,	13
" Machinery Steel,	7
" Toe Calk Steel,	5
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" Bessemer Steel,	7
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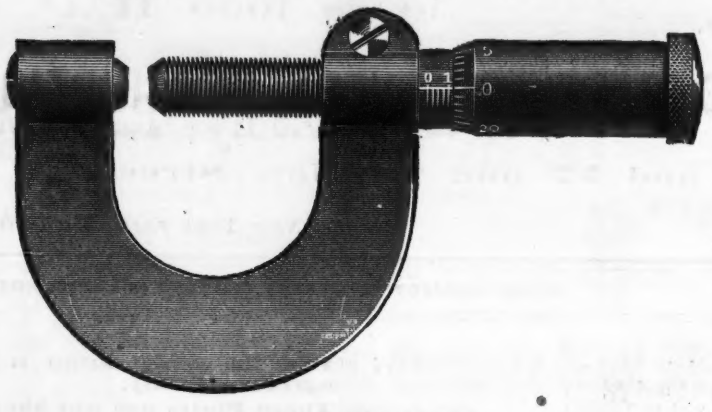

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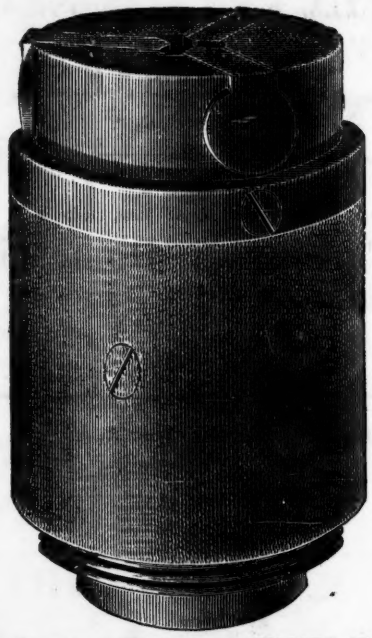

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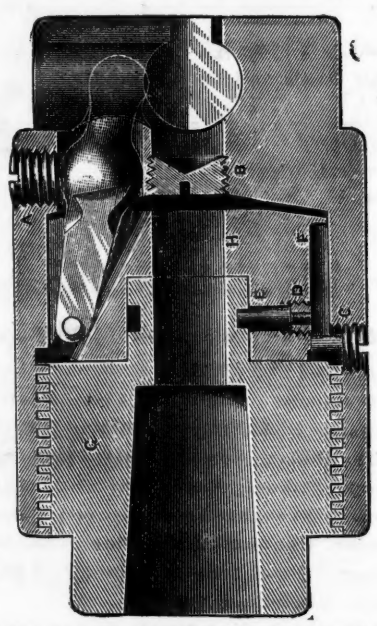

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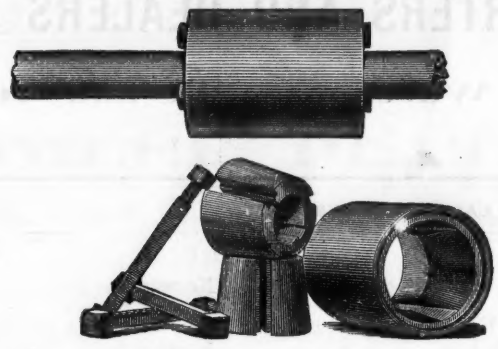

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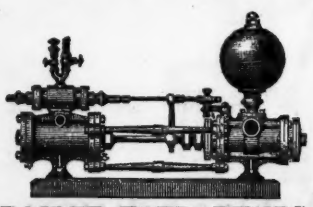

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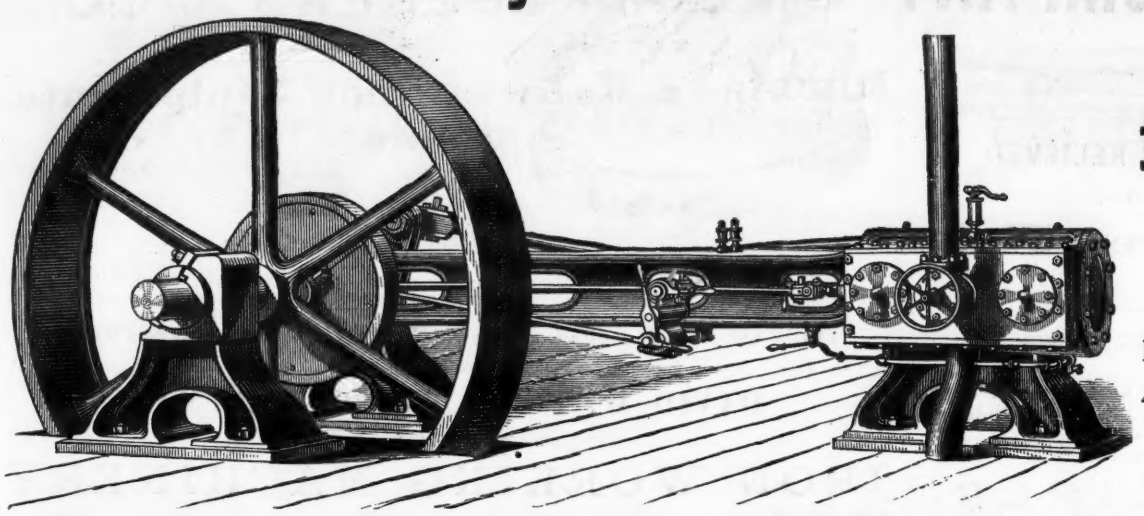

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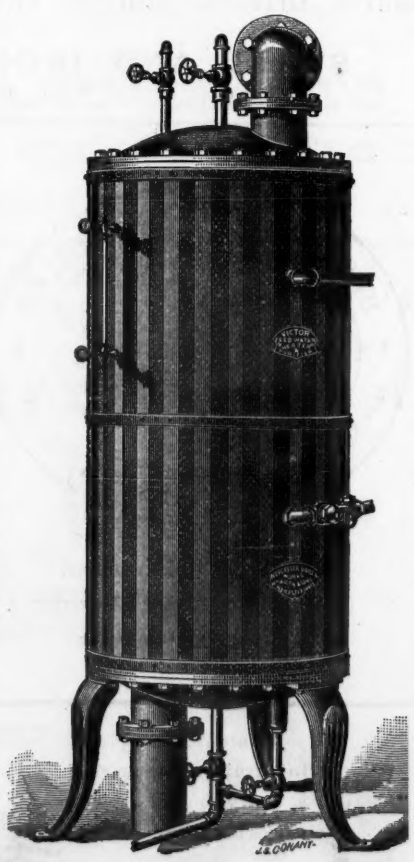

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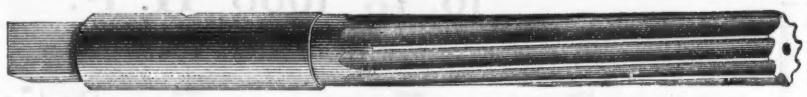

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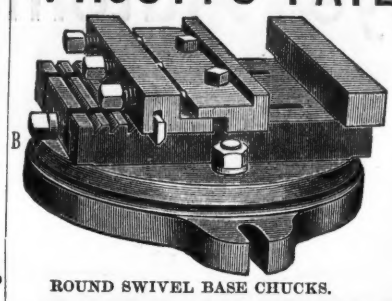

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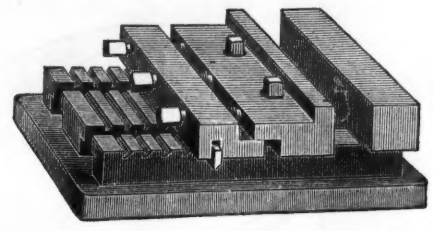

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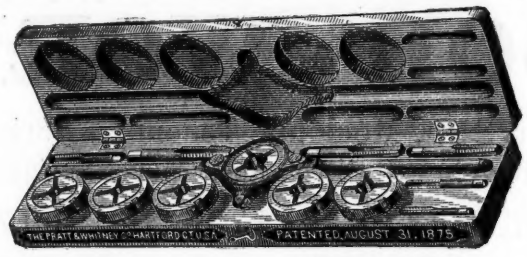

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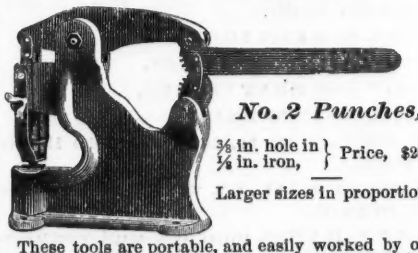

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